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LANDSCAPES AND RESOURCES IN THE BRONZE AGE OF SOUTHERN SPAIN



Editors

Martin Bartelheim,
Francisco Contreras Cortés &
Roland Hardenberg

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Preface

Resources form the basis of the existence of societies. They can be material and immaterial, and their character is culturally shaped. Resources are usually not used in isolation, but in combination with other resources – as ResourceAssemblages that can change over time as a result of complex relationships. Dealing with such ResourceAssemblages shapes cultural landscapes in which social groups have their base and organise, shape and control these landscapes in a specific, culturally formed way according to the existing circumstances.

This volume focuses on the current state of research on resource use in the Bronze Age in the south of the Iberian Peninsula with a temporal perspective up to the present time. Short-term and long-term trends of landscape design to facilitate the utilisation of resources are discussed as well as the interrelation of social dynamics and resource use.

The major questions being addressed are:

- Can a conscious landscape design be recognised that serves as a preparation for the use of resources?
- How are landscapes shaped to meet the needs of resource use? What social practices are associated with this?
- Which perceptions of resources and landscapes as well as motives for action can be detected?
- How are socio-cultural dynamics linked to the use of resources?

Landscapes have different perceptions and uses depending on the views that human groups have about the space surrounding them. During the Bronze Age, several processes of environmental, social and cultural change began in Europe and landscapes played a crucial role in the conformation and transformation of these groups. Landscapes can be understood as assemblages, because

they consist of very heterogeneous elements (soil, rocks, rivers, climate, animals, plants, people, buildings, fences and walls, paths and streets, etc.), which have a certain spatial extension, show different degrees of heterogeneity and homogeneity and are part of socio-cultural processes. Assemblage theory stresses the links and interactions between heterogeneous elements of different materiality and temporality which can become parts of larger compositions. Thinking landscapes as ResourceAssemblages provides useful insights into the dynamics of socio-cultural change as well as the use of resources and helps to explore perception, use and representation of the landscape as analytical categories. The concept of the assemblage helps on the one hand to understand how a landscape was created but also what dynamics characterise it, since the latter partly derive from the relationships between the elements. Such an approach overcomes the former contrast between natural and cultural landscapes and goes beyond the idea that humans construct their landscapes. In a landscape assemblage, humans are only one component within a much larger network (Bartelheim et al. 2021).

The landscapes of southern Spain provide an example of how landscape during the Bronze Age was both a material and immaterial resource that helped shape relationships between people and with nature. It is thus essential to explore the ecological conditions, mobility and connectivity (Chala Aldana, this volume) as well as social relationships among those communities (Bartelheim, this volume), their livestock and the surrounding environment. In the Guadalquivir valley and the adjacent mountain range of Sierra Morena, since prehistoric times suids, cattle and ovicaprines represent the main part of livestock. According to zooarchaeological evidence, suids as indicators of permanent settlements have always played a

significant role. Animal resource management represents a key strategy for the success and sustainability of human groups. Therefore, one important means to understand the importance of landscape is to study it via its use for animal breeding by examining the mobility of cattle, ovicaprines and suids as part of a social and economic strategy (Díaz-Zorita Bonilla et al., this volume). The different mobility patterns of each species represent different adaptive strategies to environmental and climatic changes as well as different economic strategies in herd management. Zooarchaeological analysis in combination with strontium $^{87}\text{Sr}/^{86}\text{Sr}$ and $\delta^{18}\text{O}$ isotope analysis in southern Spain as in many other areas of Iberia points towards seasonal movements and herd mobility in prehistoric until at least medieval times, which can be correlated with specific settlement patterns (Bartelheim et al., this volume).

The occupation of Hispano-Muslim territory by the Christians in the High and Late Middle Ages brought with it the implantation of new systems of settlement, changes in crops, alteration of livestock and forest exploitation, in short, new rural landscapes, and therefore a new spatial reality. Thus, from the very moment of the Christian conquest in Andalusia in the 13th cent. AD, land was delimited due to different factors and with a very varied ownership. As a consequence of this the so-called *dehesas* emerged, originally being open spaces in forest areas for the grazing of cattle. However, different types of pastures were created. On the one hand, the limited lands of communal use, mainly *ejidos*, meadows and *dehesas*, in which the cattle of the neighbours could graze. One also finds the so-called *dehesas de propios*, exploited for the benefit of the council. Finally, the privately owned pastures, which were used for the livestock of an individual or an institution but on numerous occasions were rented in order to obtain economic benefits. After the emergence of the widespread transhumance system, the *mesta*, in the High Middle Ages and the necessity for the establishment of drove ways, this became a constant source of conflict between resident and mobile populations (Carmona Ruiz, this volume).

In the case of the contemporary *dehesas*, processes of Spain's (second) industrialisation, mechanisation and intensification in agriculture and

live-stock farming as well as considerable socio-economic development have undoubtedly transformed the landscape's utilisation and appearance. Whereas living standards, rural and urban infrastructures or mobility patterns have changed significantly, a handful of traditional farming practices have been maintained, and today's young *ganaderos* like to relate their work to the way of life of their deeply respected ancestors. Therefore, today's values and self-conception of rural life in southern Spain need to be contextualised in the often contradictory cross-generational relations (Melles 2021). Rather than envisioning Resource-Assemblages as sequences of static arrangements, a more dynamic concept is proposed in order to account for past and present 'knots' (Ingold 2015).

In contrast to animal husbandry, plant resources represent one of the least studied topics in Iberian prehistory despite their potential not only to reconstruct patterns of plant exploitation but also to understand subsistence practices, and to improve our knowledge of plant use and human communities in the past. Therefore, the presentation here of the archaeobotanical data (seeds and fruits) available for the south of the Iberian Peninsula during the Bronze Age gives important insights into the diversity of species cultivated during this period, as well as into the exploitation of wild plants for food and other uses. Different crops such as barley and wheat (mainly free-threshing species) and several legumes have been identified while there is also a wide diversity of wild resources. Flax and poppy are also cultivated in the area. Although the number of sites studied is still limited, results suggest that plants were an important resource for the Bronze Age communities (Peña Chocarro, this volume).

In other landscapes of the Iberian south, as in the southern Levant, in Almería or Granada, there is sound evidence to demonstrate how Bronze Age communities made extensive use of the available raw materials and other resources, following the principles of self-subsistence that govern the rationality of peasant economies (see contributions of Jover Maestre et al.; Aranda Jiménez et al.; García Sanjuán/Mora Molina and Benítez de Lugo Enrich/Mejías Moreno, all in this volume). There and elsewhere in the wider region, it remains an open debate in how far this as part of individual

ResourceCultures can be directly or indirectly related to certain kinds of social dynamics. Important aspects of the use of landscape as ResourceAssemblages comprise also water management and technology, as it is demonstrated here with the region of the Rumber River in the eastern Sierra Morena and in La Mancha (Cantarero Rodríguez/Cantarero Quesada, this volume).

Other aspects of resource use in landscapes are not directly linked to subsistence. In the Bronze Age, mining for metals, mainly copper, is widely believed to have had important implications in Bronze Age economy. Traditionally, researchers have focused on the analysis of metallurgy practised by the communities of the recent prehistory of the southeast of the Iberian Peninsula, leaving in the background the extractive mining activity within the process of production of copper base metals. However, this panorama has changed in recent years, thanks to intensive fieldwork (prospecting and archaeological excavation)

above all in the eastern Sierra Morena and on the northern slopes of Sierra Nevada and Sierra de Baza (Arboledas Martínez et al., this volume). Nevertheless, there are still many open questions as to the production of metal during the Bronze Age in the Iberian South, especially as to the processes of alloying copper to obtain bronzes and the search for sources for adequate alloying metals in the landscape (Murillo Barroso/Montero Ruiz, this volume). Other important materials used for prestige and everyday items during the Bronze Age include ivory, which had to be imported from overseas (mainly Africa) (Schuhmacher, this volume), and clay for pottery that was mostly available locally near settlements (Padilla Fernández et al., this volume; Vico Triguero/Dorado Alejos, this volume).

Martin Bartelheim, Francisco Contreras Cortés,
and Roland Hardenberg

Bibliography

Bartelheim et al. 2021: M. Bartelheim/L. García Sanjuán/R. Hardenberg, Human-Made Environments. The Development of Landscapes as ResourceAssemblages. An Introduction. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), Human-Made Environments. The Development of Landscapes as ResourceAssemblages. RessourcenKulturen 15 (Tübingen 2021) 7–22.

Ingold 2015: T. Ingold, The Life of Lines (London 2015).

Melles 2021: M. Melles, The Representation of the Dehesa Landscape in Spanish Local Museums. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), Human-Made Environments. The Development of Landscapes as ResourceAssemblages. RessourcenKulturen 15 (Tübingen 2021) 35–51.

Martin Bartelheim

Societies and Resources in the Bronze Age of Southern Iberia

Keywords: Bronze Age, southern Iberia, socio-economic structure, states, cultural norms

Abstract

Against the backdrop of earlier descriptions of prehistoric social structures, this article will discuss the methods available for the analysis of archaeological evidence and the limits on interpretation, particularly with regard to the term ‘state’, using examples from the Bronze Age in the south of the Iberian Peninsula, mainly in the El Argar region. The focus is on the identification of meaningful parameters, basic resources and the range of target-oriented interpretative approaches.

Societies and Resources

The collaborative research centre SFB 1070 RESOURCECULTURES defines resources as what societies value and what moves them. Resources are the means by which actors in societies create, maintain and change social relations, entities and identities (Bartelheim et al. 2015). Resources are therefore, on the one hand, products of communal action and, on the other, sources of renewal of society, and they always combine both material and non-material dimensions. By this definition, resources can form the basis of a variety of individual, social, political and cultural processes. Dealing with such resources triggers certain socio-cultural dynamics, which are multidimensional processes of change that are closely interrelated with cultural ideas and practices. This cultural ascription defines a resource and how it is treated, which can change over time and from place to place.

Resources do not exist in isolation, but are part of networks consisting of material and non-material components. The use of any resource requires the interaction of a number of elements, such as people and animals, objects and materials, norms, forms of knowledge and infrastructures which can be described as ResourceComplexes (Bartelheim et al. 2015; 2021). Only from the interplay of these specific spatial contexts of environments, landscapes, actors, practices and orders socially-relevant resources and the socio-cultural dynamics they trigger can be explained (Hardenberg et al. 2017; Teuber/Schweizer 2020). In a diachronic view, they can often be regarded as ResourceAssemblages shaped by new, unpredictable contextualisations and the attributions of meaning to the elements over time (Bartelheim et al. 2021; Hardenberg 2021). This perspective on resources via ResourceComplexes and ResourceAssemblages can reveal, among other things, what role resources played in the emergence of social hierarchies, conflicts or communication networks. The identification of resources fundamental to prehistoric societies is an important heuristic tool for the analysis of such societies.

Social Structures in the Archaeological Record

Research into European prehistory is shaped by the lack of statements from the past that we can understand, especially written sources. Therefore, archaeological features and finds require interpretation, for which analogies are usually used (Smolla 1964; 1990; Fischer 1990; Eggert 1998; 2012a, 330–381; Veit 1998; 2000; Gramsch 2000; 2014; Schweizer 2021). In some cases, such as the use of certain prehistoric technical facilities, our

current background of experience to interpret the archaeological record is applied and thus let the sources 'speak'. Here, that perception may well not be very far from historical reality. In many areas, however, especially when cultural and social behaviours or ancient thought patterns play a role, as they do in the description of prehistoric social systems, we depend on analogies in order to make statements about inherent structures in the record (see e.g. Müller-Scheeßel/Burmeister 2005). Also, theoretical approaches from cultural sciences are frequently used, even though they are often based on the analysis of case studies from recent or sub-recent societies.

Human relationships cannot be deduced directly from the archaeological record. They require interpretation aids that are mostly drawn from parallels with similar constellations of persons and/or objects mainly from comparable situations in history, cultural anthropology or sociology. However, all these attempts to assess the nature of prehistoric societies through analogies have the basic problem that the value systems of these societies are unknown. In recent years, there have been various attempts to access these (e.g. Bokern/Rowan 2014; Hahn 2014), but the results are analogies from a modern Western perspective or that of spatially or temporally distant societies whose internal view is known due to historical or ethnographical sources. The question of transferability to prehistoric conditions thus remains.

This also applies to the topic of social structures, especially hierarchies, which is of interest here. Social hierarchy can take on various forms of expression that go beyond property and physical or military power. Among those is seniority acquired through genealogy, marriage or merit (so, *inter alia*, among the East Indian Dongria Kond [Bartelheim et al. 2016; Hardenberg 2018, 583–586]). Hierarchy is not to be confused with complexity (multiple parallel structures with similar social rank [Kienlin 2012]). The difficulty for archaeologists is above all to recognise the corresponding social structures from the accessible finds and to identify value systems behind them.

Parameters most often used to analyse archaeological features and finds for their significance for social differentiation are: labour input for the production of objects and (building) structures, size,

quantity, exclusivity of form, material or special location. The focus is mainly on grave goods, as an archaeological manifestation of the personal, as well as buildings or settlements, as an expression of a community structure or organisation. However, these require a detailed examination of their source value for the purposes envisaged here. Grave furnishings, for example, primarily reflect the values of the burial community, and possibly also those of the buried. They therefore do not necessarily reflect a social structure (Schier 2010, 382). Examples such as the Chalcolithic tholos from Montelirio (Valencina de la Concepción, province Seville, southern Spain, early 3rd mill. BC) (fig. 1), with a very elaborate burial structure and lavish grave goods, give cause for thought. There, the exclusive burial of 22 women (Fernández Flores et al. 2016) does not necessarily indicate great political power or wealth of the deceased (perhaps priestesses?). Rather, the burial record appears to be product of a presentation within a cultic-sacral realm and manifests primarily the appreciation by the burial community, or the surviving relatives (García Sanjuán et al. 2016; 2018). It is conceivable that this funerary monument represented a social or religious resource for them.

Even grave good indices determined with statistics do not necessarily offer independent criteria here. They represent an attempt to 'objectify' the discussion of parameters developed from the material and reveal many structures immanent to the material (see e.g. Sprenger 1999; Burmeister 2000). The main problem here, however, is that mostly features such as quantity, material and/or form are taken as a basis, which in turn are themselves products of (modern) interpretations. Similarly, caution with the interpretation is required when attempting to establish social hierarchies by means of the settlement system. Characteristics here are above all differences in the location, structure and character of the layout of settlements as well as in the construction and furnishing of houses. However, these should be examined to see whether there are functionally explicable differences (in the case of settlements and houses) as well as if any units can be assigned to individual persons or certain groups (especially in the case of houses) (Trebsche 2009). In recent years, scientific methods of investigating finds and features,

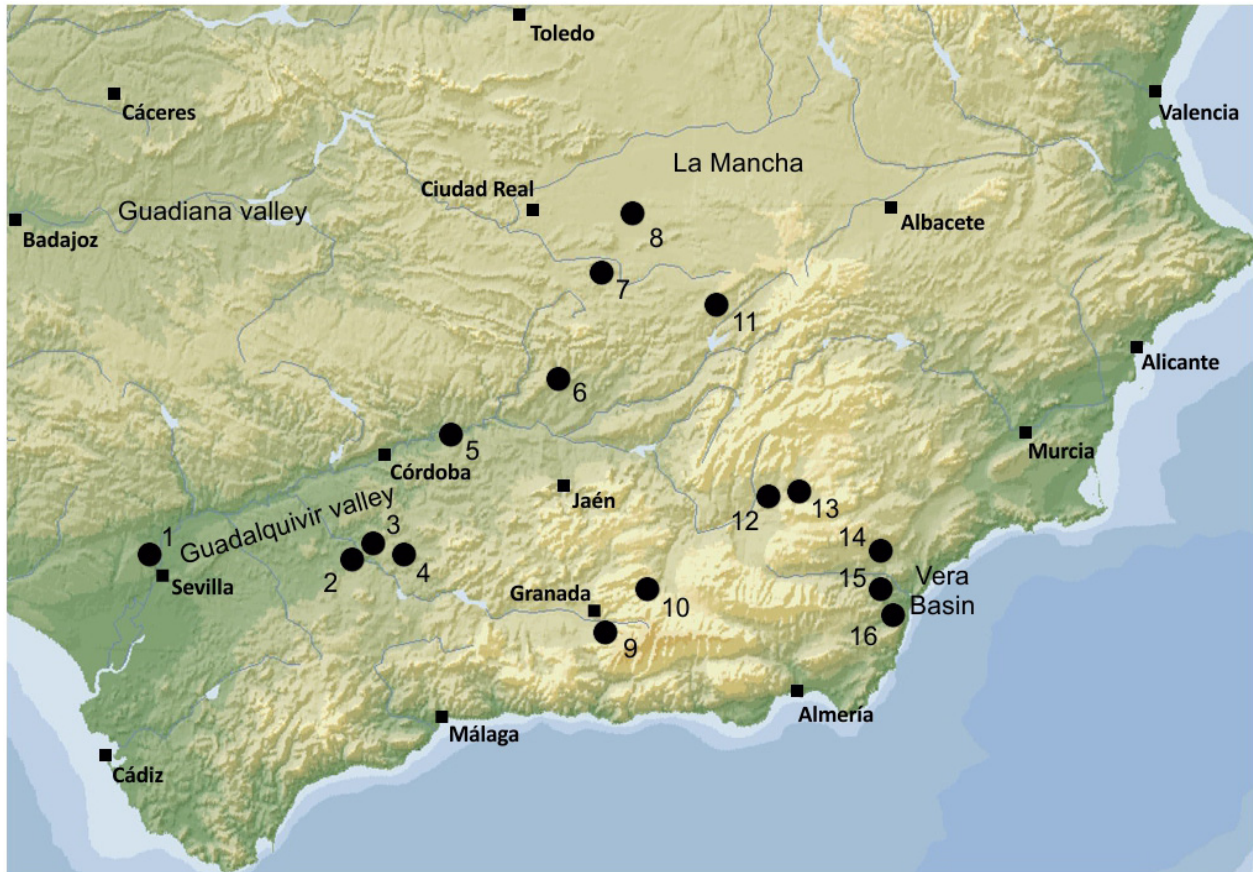


Fig. 1. Map of the sites mentioned in the text: 1. Valencina de la Concepción, 2. Zoñar, 3. Aguilar de la Frontera, 4. Monturque, 5. Llanete de los Moros, 6. Peñalosa, 7. Cerro de la Encantada, 8. Motilla del Azuer, 9. Cerro de la Encina, 10. Cuesta del Negro, 11. Castillejo del Bonete, 12. Galera, 13. Orce, 14. Fuente Álamo, 15. El Argar, 16. Gatas.

especially bioarchaeological analyses, have also developed great potential to provide information on the structure of societies (see e.g. Geller 2017; Mittnik et al. 2019; Schrader 2019). Here, of course, the necessity of a precise examination of the informative value of the analysis results for the intended historical question applies in the same way.

States in the Bronze Age?

There has been no shortage of approaches to reconstruct prehistoric social structures by means of theoretical models. Examples of ‘classics’ are the proposals of Elman Service (1962), Morton Fried (1967), Marshall Sahlins (1963), Timothy Earle (1987; 1991) and Stefan Breuer (1990; 1998), which are based on anthropological and historical case studies. In the manner of a ‘typology’, forms of society are outlined ranging from bands, tribes with

big men, chiefdoms to states (e.g. Service 1962; 1975). Due to their evolutionary character, they were and are often used worldwide in archaeology to describe a development in social hierarchies. To this end, archaeological find material is scanned for markers with which the affiliation of individual groups to a certain stage of social development can be argued (on this and on later modifications, see the descriptions in Eggert 2007; 2012b; Eggert et al. 2010, 55–59; Kienlin 2012). This is also where the approaches of Historical Materialism come in. There, forms of rule based on exploitation, violence and oppression are reconstructed via the postulate of the existence of class antagonisms in prehistoric societies (Lull/Micó 2011).

The concept of a ‘state’ as the highest stage of social evolution has been used repeatedly for several years to describe social relations during the Early and Middle Bronze Age in large parts of the southeast of the Iberian Peninsula – the so-called



Fig. 2. The Bronze Age settlement of El Argar, prov. Almería on a flat table mount above the river Antas.

‘El Argar area’ (Lull 1983; Lull/Risch 1995; Lull et al. 2011; Arteaga 1992; 2001; Risch 2012). The theoretical basis for the description of the socio-economic conditions is primarily provided by approaches of Historical Materialism. According to that, the state is based on a class society whose essential features are property, surplus, economic exploitation and an institutionalisation of power. The latter means: physical coercion, violence, domination in physical and psychological form, for example through symbols, language and ideology, up to a restriction of freedom in social reality (Lull et al. 2011). In Iberian Bronze Age research, this model has met with a rather divided response overall (on this, see e.g. Gilman 1981; 2013; Serrano Ariza 2012; Cruz Berrocal et al. 2013; Legarra Herrero 2013; Ramos Millán 2013; Aranda Jiménez et al. 2015).

The South-East Iberian Bronze Age, commonly summarised under the term ‘El Argar area’ – named after the prominent site of El Argar near Antas, Prov. of Almería (*fig. 2*) – covers one of the driest regions of the Iberian Peninsula in the present-day Spanish provinces of Alicante, Murcia,

Almería, Granada and Jaén (Aranda Jiménez et al. 2015, 23). Its comparatively well-researched cultural appearance is characterised by settlements mostly in difficult-to-reach defensive positions with an occupation that often spans the entire period of the Early and Middle Bronze Age (ca. 2,200–1,500 BC), in some cases lasts even longer (e.g. Fuente Álamo [Schubart 2001] [*fig. 3*] or Cuesta del Negro [Molina González/Pareja López 1975; Molina González 1978]). Individual smaller settlements were also found in open terrain. Intramural burials in crouched position are predominant, within stone cists, burial niches, pithoi or simple burial pits (Aranda Jiménez et al. 2015). The cultural area is also characterised by a rather similar spectrum of finds (mainly in pottery, metal and stone).

This narrow cultural canon found within a limited territory, also called the ‘El Argar norm’, at first glance appears to be highly standardised (Siret/Siret 1887; Tarradell 1950; 1965; González Marcén 1994; Arteaga 2001). Together with the interpretation of some finds related to economic practices, this formed one of the essential foundations for the development of the idea of El Argar



Fig. 3. The Bronze Age settlement of Fuente Álamo, prov. Almería situated on a small steep hillock.

as a state with regional dominions. In the course of its existence, it is also said to have shown expansionist traits, aiming above all at securing sources of raw materials as an important resource (Lull et al. 2011, 387 f.; 2017, 158). According to this model, the basis of the state was a coercive system in economic, political and social terms. It was characterised by economic exploitation of the population by a possessing class, creating a surplus that was under their control or came into their personal possession (Lull et al. 2011, 404 f.; Lull/Micó 2011). In addition, there was the dependence of individual settlements on larger ones within territorial units, mainly due to centralised production and economic practices. This domination was underpinned by an ideology that manifested itself in material terms in the uniformity of cultural traits (material goods, burial forms, ways of life) (Lull et al. 2011, 406) and thus appears as a quasi ResourceComplex. This system was based on a class society which was identified archaeologically

by differences in grave furnishings. The starting point for this was the result of a cluster analysis of grave goods in about 400 graves (Lull/Estévez 1986). Its basis, however, has never been presented in detail and the results have not been discussed for the entire cultural area using concrete evidence. Also, the implications of apparent chronological differences in the analysed grave furnishings (Lull et al. 2011, 400 f.) have not been taken into consideration.

A closer look at the factual basis of this picture sketched in a variety of accounts, however, reveals significant discrepancies. First of all, it should be noted that, as is the case everywhere, the current find record is strongly influenced by the history of research. Thus, the boundaries of what is commonly referred to as the El Argar area (Lull et al. 2011, fig. 1) essentially reflect the selective intensive research activities of individual personalities and institutions. Towards the west and north, the boundaries of that area often outlined in the



Fig. 4. The Bronze Age hill-top settlement of Peñalosa, prov. Jaén originally located on a steep promontory overlooking a deep creek valley, now filled by a reservoir.

literature are primarily due to research gaps that dissolve after an analysis of the find material available from there (Bartelheim et al. 2021; Chala Aldana, this volume). Furthermore, it must be noted that the publication of find material from sites in the El Argar area happened mostly only partially or schematically. This makes it difficult to recognise subtle but important typological differences in the find material from one region to another. Detailed fine typological analyses of finds, especially of pottery, are rare, and there is a lack of large-scale mapping of ceramic groups determined in this way, which would reveal regional differences. After an examination of the accessible finds, it then also becomes apparent that the uniformity of the find material is by no means as strong as assumed. In addition, it can be seen that, where a correspondingly good research situation permits, the transitions to the forms in neighbouring cultural areas (e.g. Guadalquivir valley, La Mancha) are more or less fluid. For comparative purposes, see for example the published material from

sites like Fuente Álamo (Schubart/Ulreich 1991, tab. 112–118; Schuhmacher/Schubart 2003, fig. 46–52, 55–63, tab. 1–39, 43, 46–75; Schubart 2012, tab. 23–46, 75–80), Gatas (Castro Martínez et al. 1999, Anexo I), Orce and Galera (Schüle 1980, tab. 88–89, 93, 97, 102, 104–106; Schüle/Pellicer 1966), Cuesta del Negro (Molina González/Pareja López 1975, fig. 16–26, 36–42), Cerro de la Encina (Arribas Palau et al. 1974, fig. 17–44; Aranda Jiménez et al. 2008, fig. 4–11), various sites in Granada province (Schubart et al. 2018), Llanete de los Moros (Martín de la Cruz 1987), Monturque (López Palomo 1993, fig. 109–141, 220), Cerro del Castillo de Aguilar and Zoñar (Ruíz Lara/Murillo Redondo 1992, fig. 4–14), Peñalosa (Contreras Cortés 2000) (*fig. 4*), Cerro de la Encantada (Sánchez/Galán 2004), the Motilla del Azuer (Fernández Martín 2010, fig. 72–227), Castillejo del Bonete (Fernández Martín et al. 2015, fig. 3–6) or various settlements in the eastern part of La Mancha (Fernández-Posse et al. 2008, fig. 108–237). These materials reveal noticeable regional differences,

which roughly correspond to those that are also known from other find groups of the Early Bronze Age in Europe, for example in the Danube region or in the Aunjetitz area (see e.g. Ruckdeschel 1987; Krause 1988; Neugebauer 1991; Stuchlík 1993; Zich 1996; Neugebauer/Neugebauer 1997; Bartelheim 1998; Bátor 2000; Lauermann 2003; Moucha 2005; Ernée 2015; Hubensack 2018; Limburský 2018; Massy 2018; Ernée/Langová 2020). This circumstance is of considerable interpretative importance, since the definition of the 'El Argar area' and the consequent consideration of this area as a closed territory in which the 'state' is said to have functioned is based on purely archaeological-typological arguments, namely the so-called 'El Argar norm' as a materially manifest expression of the rule and ideology of a centrally acting power (González Marcén 1994; Lull et al. 2011, 405 f.).

In Central Europe as on the Iberian Peninsula, the actual backgrounds of the regional similarities in material culture are unknown. What must be considered is primarily an intensive exchange within and between zones with similar cultural ideas, conventions, religion or ideology, fashions and the like (Chala Aldana, this volume), which often had connections also far beyond. These cultural elements, which by no means had to be imposed centrally and by force, include the largely undecorated, surface-smoothed and carinated design of the pottery that is found in large parts of Europe at the end of the 3rd and the beginning of the 2nd mill. BC. The shapes of the metal objects from the Early and Middle Bronze Age found in the south of the Iberian Peninsula as well as the custom of burying the deceased in single graves and in crouched positions also follow pan-European trends in many respects.

Socio-Economic Indications

The existence of personal property and exploitation as the basis of social inequality has not yet been proven in the south Iberian Bronze Age, although it is very likely that property existed in some form. With regard to the identification of personal ownership, the characterisation of grave goods as the property of the buried, or in the case

of children's graves as inherited family property (Lull et al. 2005; 2011, 401 f.) does not help. What is disregarded here is that burial procedures are actions carried out by the social communities surrounding the dead, which are performed in this way for a wide variety of reasons. These may be rooted primarily in a personal relationship to the buried person, in an ideal view of a person, in a cultic or ritual sphere, but also in the need to represent social circumstances of various kinds that need not only express hierarchies (see e.g. van der Beek 2004; Kümmel et al. 2008; Bartelheim 2012; Wentink 2020). Personal ownership of the objects in the grave and the expression of the position of an individual within a social hierarchy through them are therefore only one of many possible forms of interpretation of grave finds. However, due to the lack of insight into the value systems of prehistoric societies in the absence of written evidence, these cannot be understood today.

Unequal access to goods is often seen as another indication of the existence of social hierarchies. The identification of the accumulation of goods in certain parts of settlements and their interpretation (e.g. storage vessels as possible granaries [Risch 2012, 27 f.]) or the reconstruction of access possibilities to certain parts of settlements are based solely on the analysis of the excavation record from today's perspective. This, however, does not necessarily have to correspond to prehistoric reality. As in the case of Fuente Álamo, grain as an important resource for El Argar society could have well been stored in the highest part of the settlement not primarily as an expression of control by elites (Risch 2012, 28), but simply because it was the best protected place. The extent to which every inhabitant had access to such a part of the settlement and the goods stored there is not sufficiently documented, neither in Fuente Álamo nor elsewhere. The discovery of animal bones in certain parts of a settlement, which are usually interpreted as the remains of the consumption of the corresponding meat parts there, does not necessarily indicate exclusive meals of a certain population group residing in that area. It is just as likely that they could merely indicate a special connection of the part of the settlement in question with this consumption, in which all or large parts of the inhabitants of the place had

participated. The description of consumption habits among the Dongria Khond in Eastern India who practise comparable ritual feasts in areas of their settlements especially dedicated to that purpose can serve as an analogy here. There is a special location in a village where animals are kept for sacrifice and then killed. Their body parts and meat are then distributed among the villagers and eaten at a 'meat place' (*unga basa*) (Hardenberg 2018, 32, 564–578, fig. 2). In many respects their living conditions show similarities to those we reconstruct for Bronze Age Europe. Incidentally, common consumption and the associated ideas and rituals represent an important resource for the functioning of the social community there.

To what extent only or primarily the population in the lowlands was involved in agricultural production to supply the larger hilltop settlements (Lull et al. 2011, 393–395) or not also to a considerable extent the inhabitants of the hilltop settlements themselves, is as yet completely unknown. However, it seems most likely that the assumed 250 to 450 inhabitants of such a hilltop settlement, as in the case of Fuente Álamo (Risch 2012, 33; Bartelheim 2012, 347) had a significant share in agricultural subsistence production in the Bronze Age. In the case of Fuente Álamo, Hans-Peter Stika was able to show that all cereal plants found in the settlement of Fuente Álamo could have been cultivated in dry farming in its surroundings. Only legumes, such as broadbeans, had to be irrigated (Stika 2001, 314–316). Moreover, the numerous field weeds and spelt remains in the botanical record at Fuente Álamo testify to the fact that at least the cultivation of plant foodstuffs on a larger scale actually took place on site (Stika 1988; 2001). Similar conditions can be deduced from Antonio Gilman's and John B. Thornes' analysis of the catchment areas of several other Bronze Age sites in the Iberian Southwest (Gilman/Thornes 1985; Legarra Herrero 2013). Therefore, it can be assumed that participation in the various production processes affected significantly larger parts of the population than it might appear in a model of compulsory contributions from peripheral groups to the central places.

In this context, the exploitation of certain parts of the population by others must be regarded as unproven. Despite all the methodological difficulties, this model could only possibly be upheld, if

either the social asymmetry is shown by objectively verifiable evidence, such as relevant physical characteristics of buried persons. Another option could be to demonstrate clearly the character of dependencies between presumed central places and open lowland settlements. However, the state of research on the lowland settlements in particular is still too inadequate to be able to obtain a clear picture here (see e.g. Ayala 1991; Martínez Sánchez 1994; Cálalich Massieu/Martín Socas 1998; Martínez Rodríguez et al. 1999; López 2009; Serrano Ariza 2012; Martínez Monleón 2014a; 2014b; 2020; Soares/Tavares da Silva 2016). But also in the case of the hilltop settlements, apart from Fuente Álamo and Peñalosa (Contreras Cortés 2000), there are hardly any other larger sites (as such usually places with a size of ca. 2ha and more are considered [Legarra Herrero 2013, 151–153]) that as to now have experienced extensive modern investigation going along with sufficient publication of the find materials to allow such a detailed examination of the economic and social structure of the population. This is a necessary prerequisite to answer fundamental socio-economic questions such as the existence of social differentiation, exploitation and appropriation of property as the basis for far-reaching social models.

Archaeological evidence that would shed light on the relationship between settlements, especially between hilltop settlements, is not yet available, especially with regard to super- or subordinate orders or dependencies (see e.g. Serrano Ariza 2012). Actually, a detailed analysis of catchment zones of agrarian and other resources in the Vera basin (prov. Almería) by Legarra Herrero (2013, 154–161) and the location of the hilltop settlements suggests that this is not very likely. It is conceivable, however, that within micro-regions, forms of exchange between settlements certainly existed, especially with regard to the delivery of goods and raw materials – such as pottery, stone, metals, animals, textiles – or also craftsmanship. Such a system did not need to have been centrally controlled and based on coercion or exploitation. It could have been based, at least in part, on a division of labour between settlement communities in the region for the purpose of optimising the use of the surrounding resource landscape. From an

economic point of view, the primary orientation of the El Argar settlements seems to have been focused on subsistence, usually with independent ways of supply (Gilman/Thornes 1985; Gilman 2013; Legarra Herrero 2013). This may have formed a ResourceComplex that primarily comprised agriculture, animal husbandry, hunting, the production of the tools needed for these purposes, such as stone, metal and bone tools, as well as the production of ceramics and textiles. There is much in the archaeological evidence to suggest that it was fundamental to the development of society. In addition, exchange and connectivity, or the networks necessary for this, can be assumed to be important immaterial resources both within the small regions and in the wider regional framework. This would be supported above all by the great similarities in archaeological finds, burial customs and settlement forms in the Iberian Southeast and beyond. It is quite conceivable that ancestors could have functioned as a further immaterial, above all religious/cultural resource, as is expressed in the frequent settlement burials. Their presence close to the everyday life of the inhabitants suggests that those buried there represent a positive selection whose proximity was desired (Bartelheim 2012).

Standardised Culture as an Expression of a Coercive System?

There are no clear indications of centralised production in the hilltop settlements in the south-east of the Iberian Peninsula in connection with an imposed cultural ‘norm’ or ‘canon’ (see above; González Marcén 1994; Lull et al. 2011, 406), neither from the material typology, nor on the basis of scientific material analyses (especially provenance or technology analyses), nor on the basis of unambiguous relevant workshop finds. Material analyses of pottery are rare, and the existing metal analyses (which are still insufficient in terms of numbers and area) rather testify to a production with a local to regional distribution of the products (Bartelheim 2007, 73–81; Murillo Barroso et al. 2015). This is also evident in the distribution of Early to Middle Bronze Age dagger and halberd finds in the south of the Iberian Peninsula

(Brandherm 2003; Horn 2014, 91–106). Likewise, other clear indications pointing to an organisation beyond small regions are lacking.

The location of settlements on heights and in positions of retreat is not specific to the El Argar area, but can be observed as an innovation throughout the Early Bronze Age of southern Iberia, where this is topographically possible. There is also clear evidence that the phenomenon of settlement burials is more widespread, for example as far as the lower Guadalquivir valley (Aubet/Serna 1981; Martín de la Cruz 1987; López Palomo 1993; Belén et al. 2000; Bartelheim et al. 2021). Moreover, in the southeast of the Iberian Peninsula, burial forms are by no means uniform, as would be expected in the case of the existence of a strictly controlled norm. Research in recent years has shown clear differences here, also at the local level, which affect the entire Iberian Southeast (Aranda Jiménez 2013; 2015). In a general perspective, there is no clear archaeological evidence for a delimited territorial or cultural unit of the El Argar area. In the south of the Iberian Peninsula – again similar to what we know from other regions of Europe – one is rather faced with a cultural zone that is divided into regional groups with their respective specificities, and between which more or less fluid transitions exist. The typological similarities point to spaces of interaction, as they are shown here on fig. 5. Communication presumably took place mainly within geographical natural spaces determined by the topography, between which, however, differences were only gradual. The idea of a cultural unity of the El Argar region is primarily due to research history.

With regard to the presence of archaeological indications for violence in the El Argar area – as a constituting element for its character as a political entity – the evidence is weak. Various analyses of weaponry revealed that from the approximately 700 years duration of the Early and Middle Bronze Age in the southeast of the Iberian Peninsula, in terms of ‘specialised weapons’ that could not also have served as tools, only a total of 50 halberds and 14 swords are known (Aranda Jiménez et al. 2009; Brandherm 2003; 2011; 2012; Brandherm et al. 2012). Metallographic and experimental studies have also shown that they hardly seem to have been usable as effective fighting tools due to their

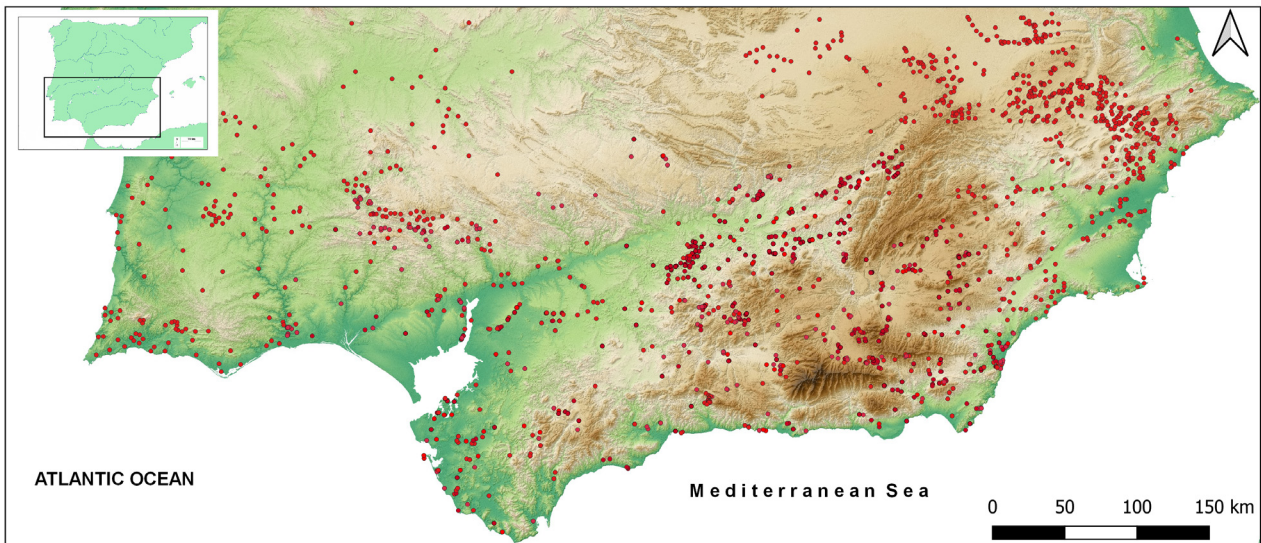


Fig. 5. Map of Bronze Age sites in the south of the Iberian Peninsula reflecting primarily differences in research intensity and with natural topographic areas representing potential main interaction zones (design: D. Chala Aldana).

material properties (Aranda Jiménez et al. 2015, 170). In the case of axes and daggers, on the other hand, which occur in large numbers in El Argar tombs of both sexes, their character as weapons is unclear, as they could also have been used as tools. There is much to be said for this, especially in the case of the daggers, as many specimens show great loss of substance due to re-sharpening as a result of intensive use (Aranda Jiménez et al. 2015, 172). Injury traces from sharp objects as direct evidence of fighting on skeletal finds in the El Argar region are hardly to be found, whereas evidence of blows with blunt objects can be found primarily on male individuals (Botella et al. 1995; Aranda Jiménez et al. 2009). This indicates that personal confrontations may well have taken place, but if the social structure had been built on the use of violence, it would have been expected that the number of verifiable combat injuries would have been much higher.

With regard to the signs of social hierarchy that can be identified from the archaeological find material, it should be noted that the differences that can be observed in the furnishings of graves are rather small when examined closely (see e.g. Schubart/Ulreich 1991). As is generally the case with grave finds, it must be assumed that the record is affected by filters of unknown strength due to burial customs, which means that here too we lack the information on the value system of

society discussed at the beginning and thus also the possibility of directly interpreting grave finds in terms of social types. Alternative approaches to this, which result precisely from the special finds of intramural burials, have already been presented several times elsewhere (Bartelheim 2007, 91–98; 2012). Overall, on the basis of the current state of research, it seems that the best way to do justice to the evidence of the Southeast Iberian Bronze Age is to assume regionally organised political, economic and social units that presumably functioned largely on a kinship basis, possibly dominated by a leading family in each case (Bartelheim 2012, 351 f.). Evidence for a coercive system and consequently for state structures in the sense of Historical Materialism is lacking in material culture, both in terms of socio-economic structure and with regard to trans-regional similarities. The state of research to date suggests that the social pyramid was rather flat than steep (Bartelheim 2012).

Synthesis and Concluding Remarks

The examples discussed show once again that the evidence for the reconstruction of social orders in prehistoric Europe is tricky and that essential features for certain models of society are often difficult to identify, especially in the case

of ideologically preconceived attempts at interpretation. Insofar as the existence of steep social hierarchies is postulated in prehistory, especially of state-like entities, when looking at Max Weber's typology of rule (as a still fundamental and widely used basis of definition), the question is compelling as to where is the conclusive archaeological evidence of an administrative or coercive staff (as an institution enforcing rule-based violence [Weber 1922, 29 f.]). Reconstructions of hypothetical army units based on a numerical or object symbolism in the distribution of weapons in hoard finds, as recently attempted in the context of the Central German Aunjetitz culture (Meller 2019), do not help here. If those numerical systems actually had a real basis, they could at least as likely also have quite different backgrounds (e.g. in ritual/religious spheres). This proposal builds on the a priori postulate of the existence of ranked societies, for whose social strata circumstantial evidence is then sought in differences in the equipment of prehistoric graves (Schwarz 2014). However, the existence of these strata would first have to be conclusively proven by independent means, which has not yet been done. Furthermore, evidence for a corresponding redistributive or otherwise centralist element in the economic structure is usually lacking, as well as clear indications of what the resources are on which this society is founded (see Hardenberg et al. 2017).

There is a wide range of views on what a state is and what characteristics determine such a political entity. The term 'state', however, has been established in archaeological research for decades, usually to describe social structures that are known and defined as city-states and empires, especially from the 4th/3rd mill. BC onwards in the Near East and Egypt. The focus there is on societies, which, in contrast to chiefdoms, are primarily characterised by a stable, not primarily kinship-structured central power organised by institutions, which establishes rules and norms and enforces them by means of monopolised violence against a population resident in a defined territory. Clear characteristics here are autonomy, charisma and stability – not least to avoid secessions. Social differentiation with clear differences between rulers and ruled is a significant feature of states, but clear social stratification appears to

be a product of state formation rather than the precondition. Individual factors in the formation of states, such as augmented population growth and subsequently population pressure with the increased need to organise the economy and social life, as well as related conflicts and wars, appear to be significant catalysts. However, these processes can only be understood as systemic processes with complex causes, which nevertheless led to remarkably similar results worldwide (Claessen/Skalník 1978, 624–629; Cohen 1978, 70; Breuer 1990, 85–226; Scheidel 2013, 6–14). Important archaeological recognition features for the existence of state structures (on this, see e.g. Stein/Rothman 1994; Renfrew 1994, 6; Schier 1998, 506; Steuer 1999, 306 f.; Frangipane 2010; Manning 2013; Garfinkle 2013) are therefore primarily representational buildings or palaces (as structural manifestations of institutionalised power), extensive storage capacities and developed sign systems or writing (as material expressions of centralised administration and redistribution) as well as increasing settlement hierarchy and high population density with indications of differences in wealth. Central places of worship, often associated with craft specialisation in the production of ritual objects, reflect the ideological foundations of rule as well as the claim to monopolise access to the supernatural (Breuer 1998, 39 f.). In the private sphere, the appearance of finds that can be regarded as luxury goods and, in craft production, a generally high technological level with the beginning of mass production of goods and occupational specialisation are important clues to the existence of an organised form of economy that can testify to stable state structures.

In prehistoric Europe, especially in the Bronze Age (the Aegean is not considered here), only a few of the characteristics listed can be identified. In no region are they present in such a concentration and range that the archaeological evidence justifies the attribution of 'state-organised' for the associated society. The same applies to conclusive evidence of comprehensive centralised economic and social repression. Therefore, and in view of the widespread use of the social category 'state' in the form just described in archaeology, the question arises as to the meaningfulness of attempts to fill such a term with alternative significances and

to apply it to other conditions. The basis of the use of these terms are in any case analogies, which in their application to the description and comparison of societies only function with a reasonably uniform use of language with clear meanings. These are conventions, for which clear and generally accepted definitions are needed. Of course, it is useful to point out that it is very likely that complex societies, some of them with a steeply stratified structure, existed in Old World prehistory, not only in the Near Eastern and Mediterranean regions. But the details of their character and the direct comparability with the civilisations known to us through historical sources must, despite many attempts, remain largely in the dark. Thus, there is no discernible reason why ideologies based by modern Western way of thinking, such as that of Historical Materialism, should bring heuristic advantages here by reducing the characteristics of the identification of states to coercive systems with private property, surplus and economic exploitation of certain population groups by others. This approach makes no sense in either theoretical context or in practical terms with regard to the archaeological context. As other approaches to describing sociogeneses point out, private property, surplus and economic/physical coercion are characteristics that can also characterise other forms of society, such as chiefdoms, which can be quite substantial in size and hierarchical in form (Breuer 1982; 1998, 26–28; Earle 1987, 294–298; 1991). In the archaeological record, especially in cultures without writing, neither personal property nor economic and social repression can be reliably proven, so that they are not applicable as criteria for defining the state.

In general, it is advisable to be aware that any attempts to describe prehistoric societies, especially if they use terms derived from historical or modern contexts (such as slaves, freemen, warriors, chiefs, princes, kings, etc.), are pure analogies. Nothing is explained by itself in the archaeological record; this only works through the projections of the attitudes of the agents. For the analogies to make sense, clear criteria are needed as well as for their application to the archaeological material (Gramsch 2000). This requires a comprehensive discussion and an attempt to create

generally accepted categories of description or classification and corresponding archaeological criteria. The basis for this should be an open debate of the whole range of possible interpretations of finds and refrain from the one-sided use of extreme interpretative approaches. In all attempts to transfer social models conceived on a theoretical basis to archaeological features, the devil is in the details of archaeological verifiability, or in the use of archaeological materials as evidence for the existence of certain social phenomena. It is difficult to follow stringent lines of argumentation on the basis of unambiguous evidence, just as it is difficult to resist the temptation to take extreme positions when interpreting findings in order to fit them into intended explanatory models.

This is by no means to advocate a general deconstructivism, but clarity in the meaning of applied terms and concepts as well as methodological cleanliness must be ensured so that, at least to a certain extent, a general validity of the categories used and a meaningful use are possible. Rigour in approach is therefore needed, with evident methodological criteria and coherent, widely accepted definitions, so that reconstructions of prehistoric social structures make sense and archaeology can be considered a sound scientific discipline.

In the south of the Iberian Peninsula, especially in the more intensively studied El Argar region, current evidence suggests that during the Early and Middle Bronze Age society was primarily organised in kinship groups. Basic units were apparently settlements at high altitudes, within which individual families could have played a leading role. It can be assumed that small regional areas around the hilltop settlements served to secure subsistence. The adjacent lowlands could have been included as part of an economic zone, where smaller, more open settlements were also located. The extent to which they were in a direct relationship with the hilltop settlements, and to which dependencies and subordinations existed, cannot be described more precisely on the basis of the current state of research, but it is conceivable. From a diachronic perspective, the basis for the functioning of the social system was obviously the ResourceAssemblage for food and subsistence,

whereby in addition to agriculture and animal husbandry, the procurement of raw materials such as ores, rock and flint from the respective surrounding landscapes was also practised.

It is likely that there was contact and exchange between the hilltop settlements, at least within interrelated geographical regions, although the character of the relationships cannot be determined in more detail. This includes the question of supra-local political units. However, it can be assumed that there were connections over greater distances, even beyond the respective regional framework, without being able to describe them more precisely. These contacts and the connectivity associated with them will also have played an important role as a resource in the socio-cultural

dynamics of the Bronze Age in the south of the Iberian Peninsula, as can be observed from the many trans-regional similarities in the finds, which have traditionally been referred to as the ‘El Argar norm’.

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Bibliography

- Aranda Jiménez 2013*: G. Aranda Jiménez, Against Uniformity Cultural Diversity. The “Others” in Argaric Societies. In: M. Cruz Berrocal/L. Garcia Sanjuán/A. Gilman (eds.), *The Prehistory of Iberia. Debating Early Social Stratification and the State* (New York 2013) 99–118.
- Aranda Jiménez 2015*: G. Aranda Jiménez, Resistencia e involución social en las comunidades de la Edad del Bronce del sureste de la Península Ibérica. *Trabajos de Prehistoria* 72, 2015, 126–144.
- Aranda Jiménez et al. 2008*: G. Aranda Jiménez/F. Molina González/S. Fernández Martín/M. Sánchez Romero/I. Al Oumaoui/S. Jiménez-Brobeil/M. G. Roca, El poblado y necrópolis argáricos del Cerro de la Encina (Monachil, Granada). *Las campañas de excavación de 2003–05. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 18, 2008, 219–264.
- Aranda Jiménez et al. 2009*: G. Aranda Jiménez/S. Montón-Subías/S. Jimenez-Brobeil, Conflicting Evidence? Weapons and Skeletons in the Bronze Age of South-East Iberia. *Antiquity* 83, 2009, 1038–1051.
- Aranda Jiménez et al. 2015*: G. Aranda Jiménez/S. Montón Subías/M. Sánchez Romero, *The Archaeology of Bronze Age Iberia. Argaric Societies* (New York 2015).
- Arribas Palau et al. 1974*: A. Arribas Palau/E. Pareja López/F. Molina González/O. Arteaga Matute/F. Molina Fajardo, Excavaciones en el poblado de la Edad del Bronce del “Cerro de la Encina” Monachil (Granada). *Excavaciones arqueológicas en España* 81 (Madrid 1974).
- Arteaga 1992*: O. Arteaga, Tribalización, jerarquización y estado en el territorio de El Argar. *Spal. Revista de Prehistoria Y Arqueología* 1, 1992, 179–208.
- Arteaga 2001*: O. Arteaga, Fuente Álamo im Territorium von El Argar. In: H. Schubart/V. Pingel/O. Arteaga, *Fuente Álamo. Teil 1* (Mainz am Rhein 2001) 161–203.
- Aubet/Serna 1981*: M. E. Aubet/M. R. Serna, Una sepultura de la Edad del Bronce en Setefilla (Sevilla). *Trabajos de Prehistoria* 38, 1981, 225–256.
- Ayala 1991*: M. M. Ayala, El poblamiento argárico en Lorca. *Estado de la cuestión* (Murcia 1991).
- Bartelheim 1998*: M. Bartelheim, Studien zur böhmischen Aunjetitzer Kultur. Chronologische und Chorologische Untersuchungen. *Universitätsforschungen zur Prähistorischen Archäologie* 46 (Bonn 1998).

- Bartelheim 2007*: M. Bartelheim, Die Rolle der Metallurgie in vorgeschichtlichen Gesellschaften. Sozio-ökonomische und kulturhistorische Aspekte der Ressourcennutzung. Ein Vergleich zwischen Andalusien, Zypern und dem Nordalpenraum/The Role of Metallurgy in Prehistoric Societies. Socio-economic and Cultural Aspects of the Use of Resources. A Comparison between Andalusia, Cyprus and the North Alpine Area. *Forschungen zur Archäometrie und Altertumswissenschaft 2* (Rahden/Westf. 2007).
- Bartelheim 2012*: M. Bartelheim, Detecting Social Structures in the Bronze Age of Southeastern Spain. In: T. Kienlin/A. Zimmermann (eds.), *Beyond Elites. Alternatives to Hierarchical Systems in Modelling Social Formations*. Volume 2. International Conference at the Ruhr-Universität Bochum, Germany, October 22–24, 2009. *Universitätsforschungen zur Prähistorischen Archäologie 215* (Bonn 2012) 339–354.
- Bartelheim et al. 2015*: M. Bartelheim/R. Hardenberg/T. Knopf/A. Scholz/J. Staecker, ‘ResourceCultures’. A Concept for Investigating the Use of Resources in Different Societies. In: A. Danielisová/M. Fernández-Götz (eds.), *Persistent Economic Ways of Living. Production, Distribution, and Consumption in Late Prehistory and Early History*. *Archaeolingua 35* (Budapest 2015) 39–49.
- Bartelheim et al. 2016*: M. Bartelheim/R. Hardenberg/A. Scholz, Arm und Reich? Alternative Perspektiven auf Ressourcen und ihre Nutzung. In: H. Meller/R. Risch/R. Jung/H.-P. Hahn (eds.), *Arm und Reich. Zur Ressourcenverteilung in prähistorischen Gesellschaften*. 8. Mitteldeutscher Archäologentag vom Oktober 2015 in Halle (Saale). *Tagungen des Landesmuseums für Vorgeschichte Halle 14* (Halle 2016) 85–100.
- Bartelheim et al. 2021*: M. Bartelheim/D. Chala Aldana/M. Díaz-Zorita Bonilla, The Known Unknowns. Bronze Age Settlement and Landscape Use in Southwestern Spain. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), *Human-Made Environments. The Development of Landscapes as Resource Assemblages*. *RessourcenKulturen 15* (Tübingen 2021) 139–162.
- Bátora 2000*: J. Bátora, Das Gräberfeld von Jelšovce/Slowakei. Ein Beitrag zur Frühbronzezeit im nord-westlichen Karpatenbecken. *Prähistorische Archäologie in Südosteuropa 16* (Kiel 2000).
- van der Beek 2004*: Z. van der Beek, An Ancestral Way of Burial. Late Neolithic Graves in the Southern Netherlands. In: M. Besse/J. Desideri (eds.), *Graves and Funerary Rituals during the Late Neolithic and the Early Bronze Age in Europe (2700–2000 BC)*. *British Archaeological Reports. International Series 1284* (Oxford 2004) 157–194.
- Belén et al. 2000*: M. Belén/R. Anglada/E. Conlin/T. Gómez/A. Jiménez, Expresiones funerarias de la prehistoria reciente de Carmona (Sevilla). *Spal. Revista de Prehistoria y Arqueología 9*, 2000, 385–403.
- Bokern/Rowan 2014*: A. Bokern/C. Rowan (eds.), *Embodying Value. The Transformation of Objects in and from the Ancient World*. *British Archaeological Reports. International Series 2592* (Oxford 2014).
- Botella et al. 1995*: M. Botella/S. Jimenez-Brobeil/J. A. Ortega, Traumatismos in Bronze Age Settlements in the Iberian Peninsula. Argar Culture. In: R. Batista/D. Campillo/T. Carreras (eds.), *IXth European Meeting of the Paleopathology Association* (Barcelona 1995) 65–72.
- Brandherm 2003*: D. Brandherm, Die Dolche und Stabdolche der Steinkupfer- und älteren Bronzezeit auf der Iberischen Halbinsel (Stuttgart 2003).
- Brandherm 2011*: D. Brandherm, Use-Wear on Bronze Age Halberds: The Case of Iberia. In: M. Uckelmann/M. Mödlinger (eds.), *Warfare in Bronze Age Europe. Manufacture and Use of Weaponry*. *British Archaeological Reports. International Series 2255* (Oxford 2011) 23–38.
- Brandherm 2012*: D. Brandherm, Huellas de uso en las alabardas argaricas. Una primera aproximación. *MARQ. Arqueología y Museos 5* (Alicante 2012) 91–102.
- Brandherm et al. 2012*: D. Brandherm/G. Aranda Jiménez/M. Sánchez Romero/S. Montón-Subías, Las armas en El Argar. Aspectos sociales, rituales y funcionales. In: *Memorial Luis Siret. I Congreso de Prehistoria de Andalucia. La tutela del patrimonio histórico* (Sevilla 2012) 607–610.

- Breuer 1982*: S. Breuer, Zur Soziogenese des Patrimonialstaates. In: S. Breuer/H. Treiber (eds.), Entstehung und Strukturwandel des Staates. Beiträge zur sozialwissenschaftlichen Forschung 38 (Wiesbaden 1982).
- Breuer 1990*: S. Breuer, Der archaische Staat. Zur Soziologie charismatischer Herrschaft (Berlin 1990).
- Breuer 1998*: S. Breuer, Der Staat. Entstehung, Typen, Organisationsstadien (Reinbek/Hamburg 1998).
- Burmeister 2000*: S. Burmeister, Geschlecht, Alter und Herrschaft in der Späthallstattzeit Württembergs. Tübinger Schriften zur ur- und frühgeschichtlichen Archäologie 4 (Münster 2000).
- Cámalich Massieu/Martín Socas 1998*: M. D. Cámalich Massieu/D. Martín Socas, El territorio almeriense desde los inicios de la producción hasta fines de la antigüedad. Un modelo. La depresión de Vera y cuenca del Río Almanzora (Sevilla 1998).
- Castro Martínez et al. 1999*: P. V. Castro Martínez/R. Chapman/S. Gili/V. Lull/R. Mico Pérez/C. Rihuete/R. Risch/M. E. Sanahuja Yll, Proyecto Gatas 2 (Sevilla 1999).
- Claessen/Skalník 1978*: H. J. M. Claessen/P. Skalník, Limits. Beginning and End of the Early State. In: H. J. M. Claessen/P. Skalník (eds.), The Early State (Den Haag 1978) 619–636.
- Cohen 1978*: R. Cohen, State Origins. A Reappraisal. In: H. J. M. Claessen/P. Skalník (eds.), The Early State. New Babylon. Studies in the Social Sciences 32 (Den Haag 1978) 31–75.
- Contreras Cortés 2000*: F. Contreras Cortés (ed.), Proyecto Peñalosa. Análisis histórico de las comunidades de la Edad del Bronce del piedemonte meridional de Sierra Morena y depresión Linares-Bailén. Arqueología, Monografías 10 (Sevilla 2000).
- Cruz Berrocal et al. 2013*: M. Cruz Berrocal/L. García Sanjuán/A. Gilman, The Prehistory of Iberia. Debating Social Stratification and the State. New Babylon. Studies in the Social Sciences 32 (New York 2013).
- Earle 1987*: T. K. Earle, Chiefdoms in Archaeological and Ethnohistorical Perspective. Annual Review of Anthropology 16, 1987, 279–308.
- Earle 1991*: T. K. Earle (ed.), Chiefdoms. Power, Economy, and Ideology (Cambridge 1991).
- Eggert 1998*: M. K. H. Eggert, Archäologie und Analogie. Bemerkungen zu einer Wissenschaft vom Fremden. Mitteilungen der Anthropologischen Gesellschaft in Wien 128, 1998, 107–124.
- Eggert 2007*: M. K. H. Eggert, Wirtschaft und Gesellschaft im früheisenzeitlichen Mitteleuropa. Überlegungen zum „Fürstenphänomen“. Fundberichte Baden-Württemberg 29, 2007, 255–302.
- Eggert 2012a*: M. K. H. Eggert, Prähistorische Archäologie. Konzepte und Methoden. Uni-Taschenbücher 2092 (Tübingen 2012).
- Eggert 2012b*: M. K. H. Eggert, Cultural Anthropology, Archaeology and Sociocultural Evolution. Exploring Submerged Territory. In: T. L. Kienlin/A. Zimmermann (eds.), Beyond Elites. Alternatives to hierarchical systems in modelling social formations; international conference at the Ruhr-Universität Bochum, Germany, October 22–24, 2009. Universitätsforschungen zur prähistorischen Archäologie. Aus dem Institut für Archäologische Wissenschaften an der Universität Bochum, Fach Ur- und Frühgeschichte 215 (Bonn 2012) 91–104.
- Eggert et al. 2010*: M. K. H. Eggert/B. Schweizer/D. Krausse/A. Dix/O. Nakoinz/S. Sievers/S. Kurz/C. Pare, Zu den kulturwissenschaftlichen Theorien und Konzepten im DFG-Schwerpunktprogramm 1171. In: D. Krausse (ed.), “Fürstensitze” und Zentralorte der frühen Kelten. 2 Volumes. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 120 (Stuttgart 2010) 19–76.
- Ernée 2015*: M. Erneé, Prag-Miškovice. Archäologische und naturwissenschaftliche Untersuchungen zu Grabbau, Bestattungssitten und Inventaren einer frühbronzezeitlichen Nekropole. Römisch-Germanische Forschungen 72 (Darmstadt 2015).

- Ernée/Langová 2020*: M. Ernée/M. Langová, Mikulovice. Pohřebiště stáří doby bronzové na Jantarové stěže. Památky Archeologické. Supplementum 21 (Prag 2020).
- Fernández Flores et al. 2016*: Á. Fernández Flores/L. García Sanjuán/M. Díaz-Zorita Bonilla (eds.), Montelirio. Un gran monumento megalítico de la Edad del Cobre. Arqueología Monografías 1 (Sevilla 2016).
- Fernández Martín 2010*: S. Fernández Martín, Los complejos cerámicos del yacimiento arqueológico de la Motilla del Azuer (Daimiel, Ciudad Real) (Granada 2010), <<http://digibug.ugr.es/handle/10481/6643>> (last access 28.04.2021).
- Fernández Martín et al. 2015*: S. Fernández Martín/L. Benítez de Lugo Enrich/N. Palomares Zumajo, La cerámica del yacimiento arqueológico de Castillejo del Bonete (Terrinches, Ciudad Real). Estudio morfológico y tecnológico. Complutum 26, 2015, 133–152.
- Fernández-Posse et al. 2008*: M. D. Fernández-Posse/A. Gilman/C. Martín/M. Brodsky, Las comunidades agrarias de la Edad del Bronce en La Mancha oriental (Albacete). Bibliotheca Praehistorica Hispana 25 (Madrid 2008).
- Fischer 1990*: F. Fischer, Analogie und Urgeschichte. In: Urgeschichte als Kulturanthropologie. Beiträge zum 70. Geburtstag von Karl J. Narr. Saeculum 41.3/4, 1990, 318–325.
- Frangipane 2010*: M. Frangipane, Different Models of Power Structuring at the Rise of Hierarchical Societies in the Near East. Primary Economy Versus Luxury and Defence Management. In: D. Bolger/L. C. Maguire (eds.), The Development of Pre-State Communities in the Ancient Near East. Studies in Honour of Edgar Peltenburg. Themes from the Ancient Near East BANEA Publication Series 2 (Oxford 2010) 79–86.
- Fried 1967*: M. H. Fried, The Evolution of Political Society. An Essay in Political Anthropology. Studies in Anthropology (New York 1967).
- García Sanjuán et al. 2016*: L. García Sanjuán/Á. Fernández Flores/M. Díaz-Zorita Bonilla, Montelirio. Valoración e Interpretación de una tumba excepcional. In: Á. Fernández Flores/L. García Sanjuán/M. Díaz-Zorita Bonilla (eds.), Montelirio. Un gran monumento megalítico de la Edad del Cobre (Sevilla 2016) 503–553.
- García Sanjuán et al. 2018*: L. García Sanjuán/M. Lucíañez Triviño/M. Cintas Peña, Ivory, Elites, and Lineages in Copper Age Iberia. Exploring the Wider Significance of the Montelirio Tomb. Madrider Mitteilungen 59, 2018, 22–65.
- Garfinkle 2013*: S. J. Garfinkle, Ancient Near Eastern City-States. In: P. Fibiger Bang/W. Scheidel (eds.), The Oxford Handbook of the State in the Ancient Near East and Mediterranean (Oxford 2013) 94–119.
- Geller 2017*: P. Geller, The Bioarchaeology of Socio-Sexual Lives (New York 2017).
- Gilman 1981*: A. Gilman, The Development of Social Stratification in Bronze Age Europe. Current Anthropology 22, 1981, 1–23.
- Gilman 2013*: A. Gilman, Were There States during the Later Prehistory of Southern Iberia? In: M. Cruz Berrocal/L. García Sanjuán/A. Gilman (eds.), The Prehistory of Iberia. Debating Early Social Stratification and the State (New York 2013) 10–28.
- Gilman/Thornes 1985*: A. Gilman/J. B. Thornes, Land-Use and Prehistory in South-East Spain (London 1985).
- González Marcén 1994*: P. González Marcén, Cronología del grupo argárico. Revista d'Arqueologia de Ponent 4, 1994, 7–46.
- Gramsch 2000*: A. Gramsch (ed.), Vergleichen als archäologische Methode. Analogien in den Archäologien. Mit Beiträgen einer Tagung der Arbeitsgemeinschaft Theorie (T-AG). British Archaeological Reports 825 (Oxford 2000).

- Gramsch 2014*: A. Gramsch, Analogie. In: D. Mölders/S. Wolfram (eds.), Schlüsselbegriffe der prähistorischen Archäologie (Münster 2014) 19–23.
- Hahn 2014*: H. P. Hahn, Die Sprache des Glanzes. Wert und Werte als Kontext von Gold. In: H. Meller/R. Risch/E. Pernicka (eds.), Metalle der Macht – Frühes Gold und Silber. Metals of Power – Early Gold and Silver. Tagungen des Landesmuseums für Vorgeschichte Halle 11 (Halle 2014) 21–31.
- Hardenberg 2018*: R. Hardenberg, Children of the Earth Goddess. Society, Marriage and Sacrifice in the Highlands of Orissa (Berlin 2018).
- Hardenberg 2021*: R. Hardenberg, The Rise of a New Millet Assemblage in India. In: T. Schade/B. Schweizer/S. Teuber/R. Da Vela/W. Frauen/M. Karami/D. Kumar Ojha/K. Schmidt/R. Sieler/M. Toplak (eds.), Exploring Resources. On Cultural, Spatial and Temporal Dimensions of ResourceCultures. RessourcenKulturen 13 (Tübingen 2021) 141–156.
- Hardenberg et al. 2017*: R. Hardenberg/M. Bartelheim/J. Staecker, The ‘Resource Turn’. A Socio-Cultural Perspective on Resources. In: A. K. Scholz/M. Bartelheim/R. Hardenberg/J. Staecker (eds.), RESOURCECULTURES. Sociocultural Dynamics and the Use of Resources. Theories, Methods, Perspectives. RessourcenKulturen 5 (Tübingen 2017) 13–24.
- Horn 2014*: C. Horn, Studien zu den europäischen Stabdolchen. Universitätsforschungen zur Prähistorischen Archäologie 246 (Bonn 2014).
- Hubensack 2018*: V. Hubensack, Das Bestattungsverhalten in Gräberfeldern und Siedlungen der Aunjetitzer Kultur in Mitteldeutschland. Forschungsberichte des Landesmuseums für Vorgeschichte Halle 14 (Halle 2018).
- Kienlin 2012*: T. L. Kienlin, Beyond Elites. An Introduction. In: T. L. Kienlin/A. Zimmermann (eds.), Beyond Elites. Alternatives to Hierarchical Systems in Modelling Social Formations. International Conference at the Ruhr-Universität Bochum, Germany, October 22–24, 2009. Universitätsforschungen zur prähistorischen Archäologie. Aus dem Institut für Archäologische Wissenschaften an der Universität Bochum, Fach Ur- und Frühgeschichte 215 (Bonn 2012) 15–32.
- Krause 1988*: R. Krause, Die endneolithischen und frühbronzezeitlichen Grabfunde auf der Nordstadterrasse von Singen am Hohentwiel. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 32 (Stuttgart 1988).
- Kümmel et al. 2008*: C. Kümmel/B. Schweizer/U. Veit (eds.), Körperinszenierung – Objektsammlung – Monumentalisierung. Totenritual und Grabkult in frühen Gesellschaften. Archäologische Quellen in kulturwissenschaftlicher Perspektive. Tübinger Archäologische Taschenbücher 6 (Münster 2008).
- Lauermann 2003*: E. Lauermann, Studien zur Aunjetitz-Kultur im nördlichen Niederösterreich. Universitätsforschungen zur prähistorischen Archäologie 99 (Bonn 2003).
- Legarra Herrero 2013*: B. Legarra Herrero, Estructura territorial y estado en la cultura argárica. Menga. Revista de Prehistoria de Andalucía 4, 2013, 149–171.
- Limburský 2018*: P. Limburský, Pohřební areály únětické kultury ve Vliněvsi (Prag 2018).
- López 2009*: J. A. López, El grupo argárico en los confines orientales del Argar. In: M. S. Hernández/J. A. Soler/J. A. López (eds.), En los confines del Argar. Una cultura de la Edad del Bronce en Alicante en el centenario de Julio Furgús (Alicante 2009) 246–267.
- López Palomo 1993*: L. A. López Palomo, Calcolítico y edad del bronce al sur de Córdoba. Estratigrafía en Monturque (Córdoba 1993).
- Lull 1983*: V. Lull, La ‘cultura’ de El Argar. Un modelo para el estudio de las formaciones económico-sociales prehistóricas (Madrid 1983).
- Lull/Estévez 1986*: V. Lull/J. Estévez, Propuesta metodológica para el estudio de las necrópolis argáricas. In: F. Olmedo (ed.), Homenaje a Luis Siret (1934–1984) (Almería 1986) 441–452.

- Lull/Micó 2011*: V. Lull/R. Micó, *Archaeology of the Origin of the State. The Theories* (Oxford 2011).
- Lull/Risch 1995*: V. Lull/R. Risch, *El estado argárico*. *Verdolay* 7, 1995, 97–109.
- Lull et al. 2005*: V. Lull/R. Micó/C. Rihuete/R. Risch, *Property Relations in the Bronze Age of Southwestern Europe. An Archaeological Analysis of Infant Burials from El Argar (Almeria, Spain)*. *Proceedings of the Prehistoric Society* 71, 2005, 247–268.
- Lull et al. 2011*: V. Lull/R. Micó/C. Rihuete/R. Risch, *El Argar and the Beginning of Class Society in the Western Mediterranean*. In: S. Hansen/J. Müller (eds.), *Sozialarchäologische Perspektiven. Gesellschaftlicher Wandel 5000–1500 v.Chr. zwischen Atlantik und Kaukasus* (Berlin 2011) 381–414.
- Lull et al. 2017*: V. Lull/R. Micó/C. Rihuete/R. Risch, *The Absolute Chronology of Argaric Halberds*. In: J. A. Barceló/I. Bogdanovic/B. Morell (eds.), *Iber-Crono 2017. Actas del Congreso de Cronometrías para la historia de la Península Ibérica*, Barcelona, 17–19 de octubre 2016. *Coeur Workshop Proceedings 2024* (Barcelona 2017) 143–162.
- Manning 2013*: J. G. Manning, *Egypt*. In: P. Fibiger Bang/W. Scheidel (eds.), *The Oxford Handbook of the State in the Ancient Near East and Mediterranean* (Oxford 2013) 61–93.
- Martín de la Cruz 1987*: J. C. Martín de la Cruz, *El Llanete de los Moros. Excavaciones Arqueológicas en España* 151 (Madrid 1987).
- Martínez Monleón 2014a*: S. Martínez Monleón, *El Argar en el Bajo Segura y Bajo Vinalopó. Patrón de asentamiento en un territorio de frontera* (Villena 2014).
- Martínez Monleón 2014b*: S. Martínez Monleón, *El poblamiento de la Vega Baja del Segura y Bajo Vinalopó en tiempos de El Argar*. In: J. A. López Padilla (ed.), *Cabezo Pardo (San Isidro / Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Excavaciones Arqueológicas Memorias 6* (Alicante 2014).
- Martínez Monleón 2020*: S. Martínez Monleón, *Caramoro I. Territorio de captación y visibilidad*. In: F. J. Jover Maestre/J. A. López Padilla (eds.), *La vida en la frontera argárica. El asentamiento de Caramoro I (Elche, Alicante)* (Alicante 2020) 25–32.
- Martínez Rodríguez et al. 1999*: A. Martínez Rodríguez/J. Ponce García/M. M. Ayala Juan, *Excavaciones de urgencia del poblado arárico de Los Cipreses, Lorca. Años 1992–1993. Memorias de Arqueología* 8, 1999, 156–182.
- Martínez Sánchez 1994*: C. Martínez Sánchez, *El poblado argárico de La Loma del Tío Ginés. Memorias de Arqueología* 9, 1994, 162–205.
- Massy 2018*: K. Massy, *Die Gräber der Frühbronzezeit im südlichen Bayern. Untersuchungen zu den Bestattungs- und Beigabensitten sowie gräberfeldimmanenten Strukturen. Materialhefte zur bayerischen Archäologie* 107 (Kallmünz 2018).
- Meller 2019*: H. Meller, *Princes, Armies, Sanctuaries. The Emergence of Complex Authority in the Central German Únětice Culture*. *Acta Archaeologica* 90, 2019, 39–79.
- Mittnik et al. 2019*: A. Mittnik/K. Massy/C. Knipper/F. Wittenborn/R. Friedrich/S. Pfrenkle/M. Burri/N. Carlich-Witjes/H. Deeg/A. Furtwängler/M. Harbeck/K. von Heyking/C. Kociumaka/I. Kucukkalipci/S. Lindauer/S. Metz/A. Staskiewicz/A. Thiel/J. Wahl/W. Haak/E. Pernicka/S. Schiffels/P. W. Stockhammer/J. Krause, *Kinship-Based Social Inequality in Bronze Age Europe*. *Science* 10, 2019, eaax6219.
- Molina González 1978*: F. Molina González, *Definición y sistematización del Bronce Tardío y Final en el sudeste de la península Ibérica*. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 3, 1978, 159–232.
- Molina González/Pareja López 1975*: F. Molina González/E. Pareja López, *Excavaciones en la Cuesta del Negro (Purullena, Granada). Campaña de 1971. Excavaciones Arqueológicas en España* 86 (Madrid 1975).

- Moucha 2005*: V. Moucha, Hortfunde der frühen Bronzezeit in Böhmen (Prag 2005).
- Müller-Scheeßel/Burmeister 2005*: N. Müller-Scheeßel/S. Burmeister, Einführung. Die Identifizierung sozialer Gruppen. Die Erkenntnismöglichkeiten der Prähistorischen Archäologie auf dem Prüfstand. In: S. Burmeister/N. Müller-Scheeßel (eds.), Soziale Gruppen – kulturelle Grenzen. Die Interpretation sozialer Identitäten in der Prähistorischen Archäologie. Tübinger Archäologische Taschenbücher 5 (Münster 2006) 9–38.
- Murillo Barroso et al. 2015*: M. Murillo Barroso/I. Montero Ruiz/G. Aranda Jiménez, An Insight into the Organisation of Metal Production in the Argaric Society. *Journal of Archaeological Science. Reports* 2, 2015, 141–155.
- Neugebauer 1991*: J.-W. Neugebauer, Die Nekropole F von Gemeinlebarn, NÖ. *Römisch-Germanische Forschungen* 47 (Mainz am Rhein 1991).
- Neugebauer/Neugebauer 1997*: C. Neugebauer/J.-W. Neugebauer, Franzhausen. Das frühbronzezeitliche Gräberfeld I. *Fundberichte aus Österreich. Materialhefte A 5.1* (Wien 1997).
- Ramos Millán 2013*: A. Ramos Millán, Villages of Wealth and Resistance in Paradise. Millaran and Argaric Chiefdoms in the Iberian Southeast. In: M. Cruz Berrocal/L. Garcia Sanjuán/A. Gilman (eds.), *The Prehistory of Iberia. Debating Early Social Stratification and the State* (New York 2013) 74–98.
- Renfrew 1994*: C. Renfrew, Introduction. In: C. Mathers/S. Stoddart (eds.), *Development and Decline in the Mediterranean Bronze Age* (Sheffield 1994) 9–20.
- Risch 2012*: R. Risch, Die Architektur der Arbeits- und Gesellschaftsteilung in den Höhensiedlungen der frühen Bronzezeit Südostspaniens. In: W. Raeck/D. Steuernagel (eds.), *Das Gebaute und das Gedachte. Siedlungsform, Architektur und Gesellschaft in prähistorischen und antiken Kulturen. Frankfurter Archäologische Schriften* 21 (Bonn 2012) 21–40.
- Ruckdeschel 1987*: W. Ruckdeschel, Die frühbronzezeitlichen Gräber Südbayerns. *Antiquitas* 11 (Bonn 1978).
- Ruíz Lara/Murillo Redondo 1992*: M. D. Ruíz Lara/J. F. Murillo Redondo, Aproximacion al bronce antiguo y pleno en el sureste de la campiña cordobesa. Los yacimientos del Cerro del Castillo de Aguilar y de Zoñar. *Anales de Arqueología Córdoba* 3, 1992, 9–35.
- Sahlins 1963*: M. D. Sahlins, Poor Man, Rich Man, Big-Man, Chief. *Political Types in Melanesia and Polynesia. Comparative Studies in Society and History* 5, 1963, 285–303.
- Sánchez/Galán 2004*: J. Sánchez Meseguer/C. Galán y Saulnier, El Cerro de la Encantada. In: R. García Huerta/F. J. Morales Hervás (eds.), *La Península Ibérica en el II milenio A. C. Poblados y fortificaciones* (Cuenca 2004) 115–172.
- Scheidel 2013*: Studying the State. In: P. Fibiger Bang/W. Scheidel (eds.), *The Oxford Handbook of the State in the Ancient Near East and Mediterranean* (Oxford 2013) 5–60.
- Schier 1998*: W. Schier, Fürsten, Herren, Händler? Bemerkungen zu Wirtschaft und Gesellschaft der westlichen Hallstattkultur. In: H. Küster/A. Lang/P. Schauer (eds.), *Archäologische Forschungen in urgeschichtlichen Siedlungslandschaften. Festschrift für Georg Kossack zum 75. Geburtstag. Regensburger Beiträge zur Prähistorischen Archäologie* 5 (Regensburg 1998) 493–514.
- Schier 2010*: W. Schier, Soziale und politische Strukturen der Hallstattzeit. Ein Diskussionsbeitrag. In: D. Krause (ed.), *“Fürstensitze” und Zentralorte der frühen Kelten. 2 Volumes. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg* 120 (Stuttgart 2010) 375–405.
- Schrader 2019*: S. Schrader, Activity, Diet and Social Practice. Addressing Everyday Life in Human Skeletal Remains (Cham 2019).

- Schubart 2001*: H. Schubart, Die Stratigraphie auf der Kuppe und am Osthang des Siedlungshügels von Fuente Álamo. Schicht- und Phasengliederung. In: H. Schubart/V. Pingel/O. Arteaga, Fuente Álamo. Teil 1. Madrider Beiträge 25 (Mainz am Rhein 2001) 40–79.
- Schubart 2012*: H. Schubart, Die Gräber von Fuente Álamo. Ein Beitrag zu den Grabriten und zur Chronologie der El Argar-Kultur. Madrider Beiträge 32 (Wiesbaden 2012).
- Schubart/Ulreich 1991*: H. Schubart/H. Ulreich, Die Funde der Südostspanischen Bronzezeit aus der Sammlung Siret. Mit Beiträgen von M. Hopf, Kulturpflanzenreste aus der Sammlung Siret in Brüssel und H.-J. Hundt, Gewebereste aus dem frühbronzezeitlichen Gräberfeld von El Argar (Almeria). Madrider Beiträge 17 (Mainz am Rhein 1991).
- Schubart et al. 2018*: H. Schubart/G. Aranda Jiménez/E. Alarcón García, Funde der El Argar-Kultur aus der Provinz Granada. Madrider Mitteilungen 59, 2018, 97–160.
- Schuhmacher/Schubart 2003*: T. X. Schuhmacher/H. Schubart, Fuente Alamo. Die Siedlungskeramik der Grabungen 1985–1991. Untersuchungen zur Chronologie und zum Siedlungsschema der El Argar-Kultur. Stratigraphisch geordnete Keramik der El Argar-Zeit aus den Grabungen 1977–1982. Iberia Archaeologica 4 (Mainz am Rhein 2003).
- Schüle 1980*: W. Schüle, Orce und Galera. Zwei Siedlungen aus dem 3. bis 1. Jahrtausend v. Chr. im Südosten der Iberischen Halbinsel I. Übersicht über die Ausgrabungen 1962–1970 (Mainz am Rhein 1980).
- Schüle/Pellicer 1966*: W. Schüle/M. Pellicer, El Cerro de la Virgen, Orce (Granada). Excavaciones Arqueológicas en España 46 (Madrid 1966).
- Schwarz 2014*: R. Schwarz, Goldene Schläfen- und Lockenringe. Herrschaftsinsignien in bronzezeitlichen Ranggesellschaften Mitteldeutschlands. Überlegungen zur Gesellschaft der Aunjetitzer Kultur. In: H. Meller/R. Risch/E. Pernicka (eds.), Metalle der Macht – Frühes Gold und Silber. Metals of Power – Early Gold and Silver. 6. Mitteldeutscher Archäologentag vom 17. bis 19. Oktober 2013 in Halle (Saale). Tagungen des Landesmuseums für Vorgeschichte Halle 11 (Halle 2014) 717–742.
- Schweizer 2021*: B. Schweizer, Gräber als Ressourcen kollektiver Identitäten in vergleichender Perspektive. Zu Grabbefunden archaischer Zeit der italischen Halbinsel auf der Basis der Diskussionen zum Vergleich in Ethnologie, Geschichtswissenschaften und Archäologie. Saeculum 70.2, 2021, 169–196.
- Serrano Ariza 2012*: R. Serrano Ariza, Fortificaciones y estado en la cultura argárica, Arqueología y Territorio 9, 2012, 49–72.
- Service 1962*: E. R. Service, Primitive Social Organization. An Evolutionary Perspective (New York 1962).
- Service 1975*: E. R. Service, Origins of the State and Civilization. The Process of Cultural Evolution (New York 1975).
- Siret/Siret 1887*: H. Siret/L. Siret, Les premiers âges du metal dans le sud-est de l'Espagne (Antwerpen 1887).
- Smolla 1964*: G. Smolla, Analogien und Polaritäten. In: R. von Uslar (ed.), Studien aus Alteuropa. Beiheft der Bonner Jahrbücher 10, 1964, 30–35.
- Smolla 1990*: G. Smolla, Analogien und ihre Grenzen. In: Urgeschichte als Kulturanthropologie. Beiträge zum 70. Geburtstag von Karl J. Narr. Saeculum 41, 1990, 326–221.
- Soares/Tavares da Silva 2016*: J. Soares/C. Tavares da Silva, Bronze Médio do Sudoeste Ibérico. Indicadores de Complexidade Social. In: A. C. Sousa/A. Carvalho/C. Viegas (eds.), Terra e Água. Escolher sementes, invocar a Deusa. Estudos em Homenagem a Victor S. Gonçalves. Estudos e Memórias 9 (Lisboa 2016) 359–384.
- Sprenger 1999*: S. Sprenger, Zur Bedeutung des Grabraubes für sozioarchäologische Gräberfeldanalysen. Eine Untersuchung am frühbronzezeitlichen Gräberfeld Franzhausen, I. Niederösterreich. Fundberichte aus Österreich. Materialhefte A7 (Horn 1999).

- Stein/Rothman 1994*: G. Stein/M. S. Rothman (eds.), *Chiefdoms and Early States in the Near East. The Organizational Dynamics of Complexity. Monographs in World Archaeology 18* (Madison 1994).
- Steuer 1999*: H. Steuer, Häuptling, Häuptlingstum. In: H. Beck/D. Geuenich/H. Steuer/D. Timpe (eds.), *Reallexikon der Germanischen Altertumskunde 13* (Berlin 1999) 291–311.
- Stika 1988*: H.-P. Stika, Botanische Untersuchungen in der bronzezeitlichen Höhensiedlung Fuente Álamo. *Madriider Mitteilungen 29*, 1988, 21–35.
- Stika 2001*: H.-P. Stika, Archäobotanische Ergebnisse der Grabungskampagne 1988 in Fuente Álamo. In: H. Schubart/V. Pingel/O. Arteaga (eds.), *Fuente Alamo, Teil 1. Madriider Beiträge 25* (Mainz am Rhein 2001) 262–336.
- Stuchlík 1993*: S. Stuchlík, V lesku zlatavého bronzu. In: V. Podborský (ed.), *Pravěké dějiny Moravy. Vlastivěda moravská N.R. 3* (Brno 1993) 233–332.
- Tarradell 1950*: M. Tarradell, La Península Ibérica en la época de El Argar. *Crónica del I. Congreso Nacional de Arqueología y del V. Congreso Arqueológico del Sudeste* (Almería, 1949) (Cartagena 1950) 72–84.
- Tarradell 1965*: M. Tarradell, El problema de las diversas áreas culturales de la Península Ibérica en la Edad del Bronce. In: E. Ripoll (ed.), *Miscelánea en Homenaje al Abate Henri Breuil (1877–1961)* (Barcelona 1965) 423–430.
- Teuber/Schweizer 2020*: S. Teuber/B. Schweizer, Resources Redefined. Resources and ResourceComplexes. In: S. Teuber/A. K. Scholz/T. Scholten/M. Bartelheim (eds.), *Waters. Conference Proceedings for “Waters as a Resource” of the SFB 1070 RESOURCECULTURES and DEGUWA (Deutsche Gesellschaft zur Förderung der Unterwasserarchäologie e.V.). RessourcenKulturen 11* (Tübingen 2020) 9–19.
- Trebsche 2009*: P. Trebsche, Architektursoziologie und Prähistorische Archäologie. Methodische Überlegungen und Aussagepotential. In: P. Trebsche/N. Müller-Scheeßel/S. Reinhold (eds.), *Der gebaute Raum. Bausteine einer Architektursoziologie vormoderner Gesellschaften. Tübinger Archäologische Taschenbücher* (Münster 2009) 143–170.
- Veit 1998*: U. Veit, Der Archäologe und das Fremde. Zur Erkenntnisstruktur der Ur- und Frühgeschichtswissenschaft. *Mitteilungen der Anthropologischen Gesellschaft in Wien 128*, 1998, 125–137.
- Veit 2000*: U. Veit, Kulturanthropologische Ansätze in der Ur- und Frühgeschichtsforschung des deutschsprachigen Raumes. Ein Blick zurück nach vorn. *Archäologische Informationen 23*, 2000, 77–98.
- Weber 1922*: M. Weber, *Wirtschaft und Gesellschaft. Grundriss der Sozialökonomik 3* (Tübingen 1922).
- Wentink 2020*: K. Wentink, *Stereotype. The Role of Grave Sets in Corded Ware and Bell Beaker Funerary Practices* (Leiden 2020).
- Zich 1996*: B. Zich, *Studien zur regionalen und chronologischen Gliederung der nördlichen Aunjetitzer Kultur. Vorgeschichtliche Forschungen 20* (Berlin 1996).

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Beyond Culture Areas

Ceramic Typologies as Indicators of Spatial Interactions between the Middle and Low Guadalquivir, Southeast and Southwest Iberia

Keywords: ceramic typologies, Bronze Age, Guadalquivir valley, space of interaction, flow of resources.

Abstract

For the Full Bronze Age, cultural historical approaches have contributed to consider southern Iberia as a region of delimited ‘territories’. The resulting cartographical representations are maps with borders that are arbitrary and do not represent the interactions that existed between human groups in southern Iberia. This paper presents an alternative approach using ceramic typologies combined with Geographical Information Systems for mapping the flow of people and resources in southern Iberia. Considering the lack of systematisation of the material record coming from the Middle and Low Guadalquivir valleys for the Full Bronze Age, this approach presents a ceramic typology for this region. However, the main goal of such a typology is not being a catalogue of a new ‘culture area’ but serving as empirical evidence of the high interconnectivity through several natural corridors that were used since prehistoric times until today. The cartographical representations obtained, show that the Middle and Low Guadalquivir valleys were not empty or low ranked regions, but were also part of the social and cultural dynamics already observed in its neighbouring regions.

1. Discussing Typologies

What is a ceramic typology for? Since the beginning of the discipline, classifying the material record according to typologies has been the primary systematic activity for any archaeological study. The action of classification brings order to the world and makes it understandable (Gnecco/Langebaek 2006). Typologies have been used mainly as a common language between archaeologists as well as a form of empirical evidence for interpreting several phenomena in the past (Moy 2019). However, after centuries of elaborating and using them, they have become something that is often taken for granted as a mere preliminary step to characterise a cultural area or an archaeological site without consideration for the implications that elaborating a typology has.

The archaeological record includes many other materials besides ceramics, and some of them have been used in archaeology to answer questions that ceramics cannot. Elaborating typologies is still the primary action in archaeological research, however, ceramic typologies have been relegated to characterise cultural areas, an activity intrinsic to cultural historical approaches; nevertheless, ceramics can provide additional information. With the aid of advances in archaeometrical studies, this paper discusses the act of classifying and comparing ceramic shapes or figures drawn on paper or digitalised.

Elaborating typologies has always been linked to characterising a geographical space; one that, most of the times, is also a product of the interpretations made by the archaeologist. One of the principal approaches in normative archaeology is the elaboration of ceramic typologies to define the material record that comes from (and belongs to) a determined place. If archaeologists give names to sites or cultural areas to identify them, typologies are the character behind such names. However, typologies have a problem: they tend to universalise (Gnecco/Langebaek 2006). Today, such generalisations, based on ceramic typologies and cultural areas, are masking other ways of reading space and materials in the past.

Spatial delimitation of cultural areas has been another traditional activity of normative archaeology, along with the elaboration of models of dispersion (or diffusion) of a culture. Ceramic typology has been deeply involved with both. Such models are possible thanks to the identification of materials in a determined area. Thereafter, normative archaeologists delimit a 'territory' according to the presence or absence of ceramic types and then give it a name. If materials are dispersed in big areas with diverse environments and settlements very distant from each other, models of dispersion and cultural diffusion start to be considered. The problem behind this is that these archaeologically defined cultural areas are assumed to be real entities, existing in the past, and further material evidence is adapted to the hypotheses of the researchers.

For example, in southern Iberia, cultural historical approaches have, since the beginning, defined the way of perceiving and representing space in the past. For the Bronze Age (ca. 2200–1550 BC), two main cultural areas in the southeast and the southwest corners have been identified. The first of these cultures has been known as El Argar and the second as Southwestern Bronze. From the very first moment they were characterised, around the end of the 19th cent. AD, sites as El Argar or the funerary contexts along the Algarve and Alentejo regions were approached under a cultural historical perspective (Aranda Jiménez et al. 2015; Parreira 2014), which aimed to recognise and characterise

'territories' with a cultural identity. Such identity was first represented in typologies of ceramics and metal objects.

Particular traits (such as the Argaric cups, the bronze 'halberds', 'daggers' or the carinated bowls from Algarve funerary cists) defined the identity of these cultures. The presence or absence of such traits in other sites (found years and decades later) defined their 'influence' (Tarradell 1950; Viana 1953; Blance 1971). Once several new Bronze Age sites were discovered and excavated during the first decades of the 20th cent. AD, Argaric traits defined the existence of such period in several sequences or contexts identified. At some point El Argar was considered as a culture present all over the Iberian Peninsula (Almagro Gorbea 1997).

This idea was abandoned during the 1940s, when a new territorial model of El Argar based on more organised typologies and more sites identified was proposed. Tarradell (1950) presented a cartographical representation of a 'territory', which originated in the southeast next to the Mediterranean coast and expanded towards the north and the west (Tarradell 1950). During the next decades, the characterisation of new funerary sites along the Algarve and Alentejo regions also led the archaeologists to consider the southwest as a region with its own identity and geographical extension (Blance 1971; Schubart 1974; Parreira 2014).

Such territorial models were also supported by discussions regarding the interaction among Bronze Age groups. For example, diffusionist models were the first used for explaining both the origin and expansion of Argaric traits (Aranda Jiménez et al. 2015; Carrillo García 2018). However, since the 1960s, autochthonist models focused on regional interactions, considering them as the cause of territory expansion (Aranda Jiménez et al. 2015). Among the changes occurring during the Bronze Age, the raise of class societies and the end of megalithic communalism (García Sanjuán 1999; Nocete 2001; Ramos et al. 2005) were considered mechanisms that triggered the expansion of the Argaric territory, together with the seek for new mining sites, which supported the hierarchical social structure (Lull 1983; Lull et al. 2010; Aranda Jiménez et al. 2015).

Although settlements identified as Argaric provided empirical evidence of the drastic social and cultural changes occurring during the Bronze Age in the whole region, this evidence ended up being absorbed by the effort to prove the existence of a state in this region. In the southwest, on the contrary, the models of spatial characterisation focused mainly on showing autochthonous cultural expressions rather than political entities controlling a territory.

El Argar has been considered an ancient state (Lull 1983; Lull/Estévez 1986; Schubart/Arteaga 1986; Nocete 1988; Arteaga 1992). The rise of elites and the control of social production along a delimited territory, via social coercion of small settlements, is one of the main characteristics of this hypothesis. Cultural historical perception of El Argar as a 'real' territory (not as a model elaborated by the archaeologists) went as far as considering territorial expansions and cultural diffusions as part of a conflictive interaction between the local elites and the peripheries (Arteaga 1992; 2000; Nocete 1988). This meant that the presence or absence of Argaric materials ended up associating the settlements to the dynamics around the conflictive and violent power relationships in the frame of the 'Argaric state'.

The ceramic typology elaborated for El Argar was also adapted to the hypotheses regarding the existence of a state, to the point that it became one of the main pieces of empirical evidence of the so-called 'Argaric norm' (*norma argárica* in Spanish). Apart from uniform characteristics in the funerary expressions and the settlement patterns, the 'Argaric norm' was based on the homogeneity in the materials produced and used (González Marcén 1994). The homogeneity of the ceramic types identified in the Argaric settlements was interpreted as part of a specialised and standardised production (Lull et al. 2010; 2013) all in the frame of a controlled production by the elites.

The presence of Argaric materials outside the Argaric territory (delimited by archaeologists) was interpreted by some as evidence of a territorial expansion of El Argar (Escacena Carrasco/Berriatúa Hernández 1985), by others as acculturation (Ruiz-Lara 1987) and still by others as simply exchanges

between two different and autochthonous cultures (Aubet Semmler et al. 1983; López Palomo 1993).

However, it is necessary to distinguish two levels of interpretation of the material record to clarify the nature of such debate. The first level is the one made from the facts, the empirical evidence. The second is the one made for generalising and to give explanations about social and cultural phenomena.

Indeed, the uniformity in the materials and the diffusion of such uniformity along southeast Iberia can be seen in several Bronze Age sites. Departing from the first level of interpretation, it is possible to also see the expansion of some Argaric materials beyond the area where such uniformity was more concentrated. The presence of Argaric materials in several corners of southern Iberia can be considered as cultural diffusion; but how did this diffusion occur?

In the second level of interpretation, the presence of materials is hypothesised in several ways, meaning that there is no certainty about the real processes going on. Diffusion of a ceramic type as mentioned above, can be correlated with the expansion of a territory, an acculturation process, or a mere exchange. However, what about taking one step back, to the first level, and consider for a moment the presence of ceramics as mere movements of people sharing ideas and values?

The dispersion of ceramic types, architectural styles, settlements, or funerary patterns is irrefutable evidence of at least one person that moved carrying an object that represented socially shared ideas and values linked to the style of the object itself. Interaction existed; a fact researchers can agree upon without discussion. Archaeologists try to link such values and ideas to the processes of social and cultural change that occurred during the Bronze Age. However, whether such ideas or values were linked to coercion or territorial control processes depends more on the ideas and values of the researcher than on the evidence itself. This is the second level of interpretation.

The second level of interpretation has direct influence on the cartographical representations made of the space. The borders of the 'Argaric territory', made from the identification of 'Argaric traits'

in southeast Iberia, are interpretations that sustain and support ideas regarding coercion and land control. The same goes with ceramic typology. The 'Argaric typology' was used for representing standardised production processes, territorial expansions, or acculturation processes; however, in doing so it left behind the first level of interpretation and went directly to the second, which embraces the hypotheses purposed by the researcher.

Such generalisations are the ones that mask alternate ways of reading spaces and materials in the past. According to Gnecco and Langebaek, typologies, as any other social product, make part of ideologic struggles, that is, the approach itself is the product of the differences between schools of thought during the consolidation of archaeology as a discipline. Both authors reflect on how 'typological thinking' has been linked, from the beginning, to the conformation of nation-states and colonialist expansion (Gnecco/Langebaek 2006). It is evident that 'Argaric typology' has an historical frame linked with the scientific paradigm of the researchers analysing El Argar.

The theoretical frame of the interpretations about El Argar is not completely linked to the set of evidence that exists, mainly because El Argar has been, and is still, treated as a culture area, and is now also treated as a state. Cultural historical approaches sometimes abandon the first level of interpretation and go immediately to the second, directly linking the material record found with, in this case, representations of controlled territories and standardised production processes. According to Gnecco and Langebaek, with the shift to neo-evolutionist approaches for classifying societies, archaeologists continued using a historicist attitude which led them to 'confirm' the existence of types already linked to the theoretical framework of the researcher. In particular archaeologists were looking for what, beforehand, they already knew they would find (Gnecco/Langebaek 2006).

It is even more complicated if the study area is not El Argar, but an area that has been understudied and does not have enough material record to be characterised in the way El Argar was. The Middle and Low Guadalquivir valley, west of the 'Argaric territory', has been considered a gap between the southwest and the southeast, and, at the same time, as a periphery of the 'Argaric state'.

There have been several typological studies, one for each Bronze Age site found along the valley, however, there is no clear relationship between the material record present in the sites identified and the 'Argaric phenomenon', which leads to different interpretations than the ones mentioned above.

If 'Argaric research' is focused on going straight to finding the state, the same occurs with the sites outside its 'territory'. Once sites outside the 'Argaric territory' are found, they are adapted to the proposed model and become simple peripheries of it, with researchers ignoring how these interpretations possibly insert bias into their results. At the end, given the few stratigraphic sequences and chronologies for the Middle and Low Guadalquivir, the interpretations depend more on the opinions of the researchers than on what the evidence shows.

A ceramic typology for the Middle and Low Guadalquivir valley is presented here, but not oriented towards characterising a new cultural area. This typology is elaborated mainly for providing evidence for interactions between settlements during the Bronze Age, and to show that the Middle and Low Guadalquivir valley regions were not empty places or low ranked regions between two powerful 'territories'. This ceramic typology is linked to a Geographical Information System (GIS), with the intention of generating a cartographic representation of southern Iberia based on the material evidence that the land itself provides.

As with any other research, this project also has the intention of showing an alternative way of perceiving this region. By departing from the first level of interpretation, we consider the Middle and Low Guadalquivir valley as regions that make up part of a landscape, which was used as a resource for shaping and modifying social and cultural relations between human groups during the Bronze Age. The cartographic model presented here, has been made without reference to borders, ethnic affiliations or other categories linked to the traditional paradigms leading the research today.

All the steps made for elaborating the typology are explained, as well as the procedures followed with the GIS, in order to keep the reader aware at all times of the treatment of the data, without jumping directly to interpretations.

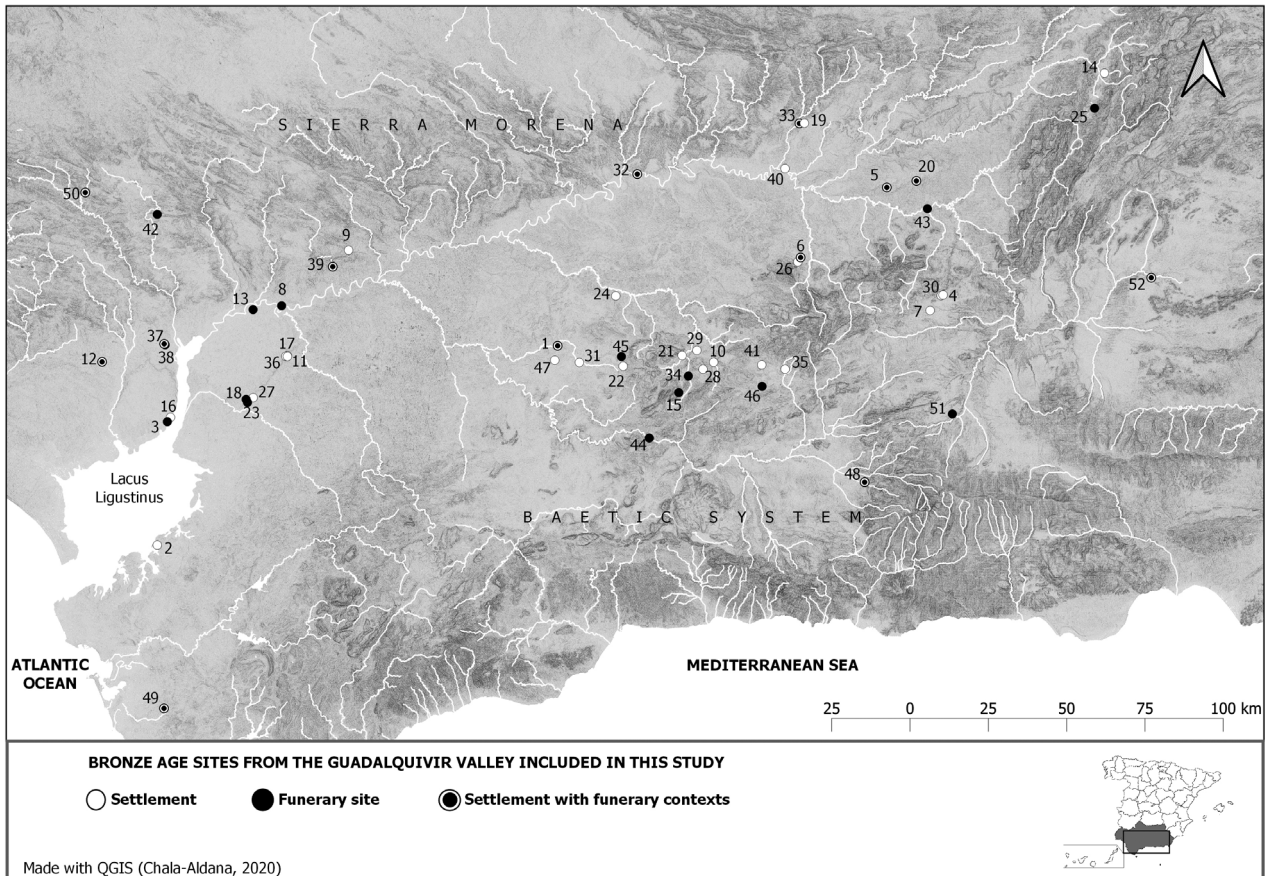


Fig. 1. Bronze Age sites in the Guadalquivir valley included in this study. For site names see table 1.

2. Ceramic Typology of the Middle and Low Guadalquivir Valley

The typology was made with 604 ceramic fragments, taken from pictures in several articles, books and reports published during the last 80 years. These reports belong to 47 sites facing the Guadalquivir valley, covering today's provinces of Huelva, Seville, Córdoba and Jaén (*fig. 1*). The Jaén sites have been included for spatial comparisons (see next section). This research could have used the terms 'provinces of Seville and Córdoba' or 'Andalusia' to define its study area. Indeed, most of the sites here referred are located in such 'territories'. Likewise, the sites database used for GIS analyses comes from the Heritage Institute of Andalusia (IAPH). At a first impression, the results produced could be geographically biased, but only if we insist on bringing the term Andalusia into this perception. Data can be read in alternative ways, as there is no concept of 'Andalusia' during the Bronze Age. So, the sites here selected for

analyses, despite being in the limits of the current Autonomous Community of Andalusia, are not representing Andalusia in any way.

There are only eleven sites with published radiocarbon chronologies confirming their occupation during the Full Bronze Age. Considering the low amount of stratigraphic sequences with radiocarbon dates for the Middle and Low Guadalquivir valley, it was decided to use the term Full Bronze Age to refer to the period between 2200–1550 BC. This term is not as structured as the chronologies from neighbouring regions, but recognises the lack of elements for differentiating Early or Middle phases (Bartelheim et al. 2021). Until having significant evidence to clear differentiate phases between this span of time, its use is recommended. The materials coming from sites without radiocarbon chronologies were associated with this period by comparing their material record with typologies elaborated from Bronze Age sites dated within the period mentioned above (mainly Argaric). These comparisons depended on the criteria of

Nº	Abbr.	Name of the Site	Type	Location	Province	Reference
1	AGU	Castillo de Aguilar	Settlement & Funerary	Aguilar de la Frontera	Córdoba	Junta de Andalucía 1987; Ruiz-Lara/Murillo Redondo 1992
2	ALC	Calle Alcazaba	Settlement	Lebrija	Sevilla	Caro Bellido et al. 1987
3	ARC	Cerro del Arca	Funerary	Puebla del Río	Córdoba	Escacena Carrasco 1980
4	ARR	Arroyo Salado	Settlement	Cabra del Santo Cristo	Jaén	Segovia Fernández 2004
5	BAE	Cerro del Alcazar	Settlement & Funerary	Baeza	Jaén	Zafra de la Torre 1991; Zafra de la Torre/Pérez Bareas 1992
6	BAJ	Marroquíes Bajos	Settlement & Funerary	Jaén	Jaén	Perales 2008; Pérez Bareas/Sánchez Susi 1999
7	CAB	Cabeza Montosa	Settlement	Cabra del Santo Cristo	Jaén	Segovia Fernández 2004
8	CAN	Canama	Funerary	Alcolea del Río	Sevilla	Sierra Alonso 1993
9	CAR	El Carrasco	Settlement	Puebla de los Infantes	Sevilla	Ojeda Calvo 1990
10	CAS	El Castillarejo	Settlement	Priego de Córdoba	Córdoba	Murillo Redondo 1990
11	CGF	Calle General Freire	Settlement	Carmona	Sevilla	Rodríguez 1999
12	CHI	Chichina	Settlement & Funerary	San Lúcar la Mayor	Sevilla	Fernández/Ruiz Mata 1976
13	CML	Cortijo María Luisa	Funerary	Cantillana	Sevilla	Santana Falcon 1990
14	COJ	Cerro de la Coja	Settlement	Orcera	Jaén	Crespo García/Pérez Bareas 1990
15	COR	Los Cortijillos de la Sierra	Funerary	Priego de Córdoba	Córdoba	Carmona Ávila 1997
16	CSJ	Cerro de San Juan	Settlement	Coria del Río	Sevilla	García Rivero/Escacena Carrasco 2015
17	CTO	Calle Torre del Oro	Settlement	Carmona	Sevilla	Román Rodríguez 2004
18	CVQ	Cueva del Vaquero	Funerary	Alcalá de Guadaíra	Sevilla	Domínguez Berenjeno/Fernández 2008
19	ENC	Castillo Baños de la Encina	Settlement	Baños de la Encina	Jaén	Castillo et al. 1990
20	ERA	Eras del Alcázar	Settlement & Funerary	Úbeda	Jaén	Ruiz Fuentes 1999
21	ESP	El Esparragal	Settlement	Priego de Córdoba	Córdoba	Murillo Redondo 1990
22	FUE	La Fuente del Río	Settlement	Cabra	Córdoba	Delgado Fernández/Vera Rodríguez 1996
23	GAN	El Gandul	Funerary	Alcalá de Guadaíra	Sevilla	Hurtado Pérez/Amores 1984; Pellicer Catalán/Hurtado Pérez 1987
24	GUT	Guta	Settlement	Castro del Río	Córdoba	Carrillero Millán/Martínez Fernández 1985
25	HOR	Hornos de Segura	Funerary	Hornos	Jaén	Maluquer de Motes 1974
26	JUA	Calle Juanito el Practicante	Settlement	Jaén	Jaén	Serrano Peña 1999

Nº	Abbr.	Name of the Site	Type	Location	Province	Reference
27	MAI	Mairena del Alcor	Settlement	Mairena del Alcor	Sevilla	Fernández Chicarro 1946
28	MAR	Cueva de los Mármoles	Settlement	Priego de Córdoba	Córdoba	Carmona Ávila 1999
29	MES	La Mesa	Settlement	Fuente Tójar	Córdoba	Murillo Redondo 1990
30	MOL	Molino Barranco	Settlement	Cabra del Santo Cristo	Jaén	Segovia Fernández 2004
31	MON	Castillo de Monturque	Settlement	Monturque	Córdoba	López Palomo 1993; Márquez 1987
32	MOR	Llanete de los Moros	Settlement & Funerary	Montoro	Córdoba	Martín de la Cruz 1987
33	PEN	Peñalosa	Settlement & Funerary	Baños de la Encina	Jaén	Alarcón García et al. 2008; Contreras Cortés et al. 1987b; 1990; Moreno Onorato et al. 2012
34	PIR	El Pirulejo	Funerary	Priego de Córdoba	Córdoba	Asquerino 1992; 1999
35	RIB	La Mesa	Settlement	Ribera Alta	Jaén	De la Torre Peña/Aguayo de Hoyos 1979
36	SAN	Plaza de Santiago	Settlement	Carmona	Sevilla	Belén et al. 2000; Cardenete López et al. 1992; Gómez Saucedo 2003
37	SEB	Cobre las Cruces (Sector B)	Settlement & Funerary	Guillena	Sevilla	Hunt Ortíz 2012
38	SEK	Cobre las Cruces (Sector K)	Funerary	Guillena	Sevilla	Hunt Ortíz 2012
39	SET	Setefilla	Settlement & Funerary	Lora del Río	Sevilla	Aubet Semmler et al. 1983
40	SEV	Sevilleja	Settlement	Espeluy	Jaén	Contreras Cortés et al. 1987a
41	SMR	San Marcos	Settlement	Alcalá la Real	Jaén	De la Torre Peña/Aguayo de Hoyos 1979
42	TRA	La Traviesa	Funerary	Almadén de la Plata	Sevilla	García Sanjuán/Vargas Durán 1995; García Sanjuán 1997
43	UBE	Úbeda la Vieja	Funerary	Úbeda	Jaén	Molina et al. 1978
44	VAL	Valdearenas	Funerary	Iznájar	Córdoba	Hitos Urbano 1990
45	VEL	La Veleña	Funerary	Cabra	Córdoba	Delgado Fernández/Vera Rodríguez 1996
46	VIL	Villalobos	Funerary	Alcalá la Real	Jaén	De la Torre Peña/Aguayo de Hoyos 1979
47	ZON	Castillo de Zóñar	Settlement	Aguilar de la frontera	Córdoba	Ruiz-Lara/Murillo Redondo 1992
48	CEN	Cerro de la Encina	Settlement & Funerary	Monachil	Granada	Arribas et al. 1974
49	BER	Cerro del Berrueco	Settlement & Funerary	Medina Sidonia	Cádiz	Escacena Carrasco/Berriatúa Hernández 1985
50	TRS	El Trastejón/ La Papúa	Settlement & Funerary	Zufre	Huelva	Hurtado Pérez et al. 2011
51	NEG	Cuesta del Negro	Funerary	Purullena	Granada	Contreras Cortés 1986
52	ORC	Orce	Settlement & Funerary	Orce	Granada	Schüle 1980

Table 1. Bronze Age sites included in this study.

every researcher. For our typology, the selection of non-dated sites considered the following aspects:

- The stratigraphic situation of the findings: Some of the findings published are above Chalcolithic layers and below Iron Age strata and are also associated with Argaric or Southwestern Bronze (dated) materials.
- The similarities noted when comparing the material record: Archaeologists evidenced some similarities between their findings and those already identified for Bronze Age sites regarding shapes, pottery treatments, and contexts (e.g. the findings in cists burials).
- The pictures of the material record published: They are the most important aspect for developing this typology. The drawings of the materials found were suitable for comparisons only if they had good quality and scale. Pictures without scale or with poor quality were excluded.

Despite having hundreds of Bronze Age sites reported in the IAPH database, most of them consist only of material collected from surface, or are from sites with reports that have not been published yet, making them unsuitable for the selection. The sites selected are presented on table 1.

The first 47 sites (AGU to ZON) are the ones selected for analyses, the last five (EN to ORC) belong to Bronze Age sites already published and are useful for comparison. These five comparative sites belong mainly to regions surrounding the Guadalquivir basin. Cerro de la Encina (CEN), Orce (ORC) and Cuesta del Negro (NEG), belong to the Baza and Guadix valleys, one of the western regions of the so-called ‘Argaric territory’. Cerro del Berrueco (BER) belongs to the estuarine region next to the Atlantic coast, and El Trastejón/La Papúa (TRS) belongs to the Sierra Morena region, which is linked to the Guadiana valley and part of the so-called Southwestern Bronze region.

It is possible that some sites have been unintentionally overlooked or not taken into account (for example the ones linking the region of the Meseta, or the ones from Málaga). However, the methodology applied here is cumulative, meaning that any new regions or materials found in the future can be included into the databases and analyses. The typology elaborated here is inclusive; it does not intend to express a ‘closed system’, but rather,

aims for the opposite. This typology hopes to show how typologies can be made, and used, as open systems for evidencing interactions. In the same direction, GIS analyses are also cumulative, meaning that any region outside the study area that has not been included yet can be included in future runs. As the study area needed a first delimitation, it was decided to focus on the floodplains and first elevations facing the Guadalquivir valley. This does not mean that mountains were natural limits or separated people from different regions. Indeed, communication existed across them. However, the study area needed a starting point, a first delimitation, that possibly, with the methodology presented here (see next section), can only be broadened.

Each of the drawings of ceramics from the sites was scanned and the scans were edited with an image manipulation software,¹ which generated a layer for each of the 604 pieces of ceramics (fragmented or complete) identified. All layers were adjusted to the same ratio (1:2), making them suitable for comparisons. The layers were grouped, and the typology was elaborated under the following criteria:

- The first to be organised were the completely preserved ceramics; it helped to define the forms present.
- Each form consists of basic shapes, representing the general attribute of the vessel and its identity/functionality compared to other forms. For this typology, five forms were identified:
 - Form 1 (bowls) (*cuencos* in Spanish): Open recipients with a diameter between 1.5x or 2.5x their height (Heras y Martínez 1992) (*fig. 28–32*).
 - Form 2 (*orzás*): This is the Spanish word for a vessel similar to a pot. It has an open mouth (which is smaller than a pot), and a flat or convex base and one or more handles (Caro Bellido 2008) (*fig. 33–34*).
 - Form 3 (*tulipas*): This is the Spanish word for a low-carinated vessel, with a convex base, an open mouth and a curve-everted body. Its shape resembles a tulip flower, thus the use of this name (*fig. 35*).
 - Form 4 (globular vessels) (*fig. 36–38*).
 - Form 5 (cups) (*fig. 38*).

¹ GIMP (GNU Image Manipulation Program).

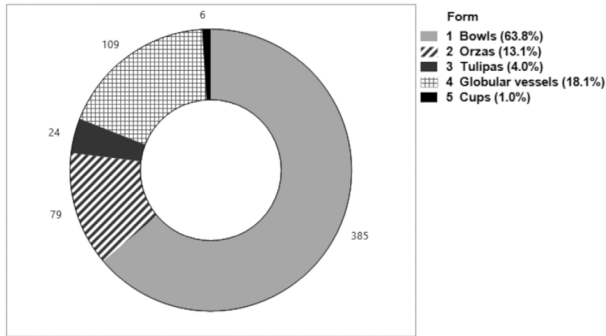


Fig. 2. Distribution of the ceramics analysed according to the forms.

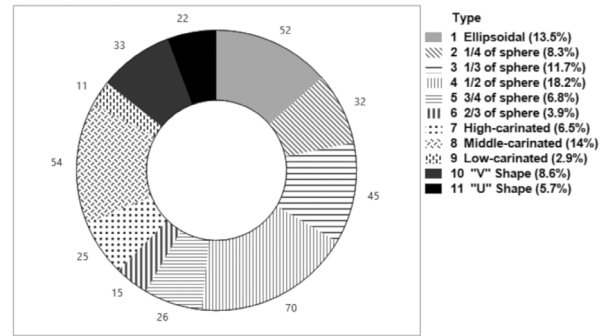


Fig. 3. Distribution of the bowls according to the types identified.

- Each form has types which belong to variations in the general shape of the vessel. This variation does not modify its identity or functionality.
- Some types have subtypes, which belong to variations in specific parts of the vessel. Most of the subtype variations in this typology are present in the shape or the angle of the rims.
- The fragments were grouped according to their resemblance to the shapes of complete ceramics. We took great care to make a complete match (in size or angle) between the fragment and the complete vessel; for this the image manipulation software was a useful tool for overlapping every piece against another, reducing the probability of errors.
- The typology proposed here only intends to be the first step towards better organising the material record of the Bronze Age in the Guadalquivir valley. Further studies (based on first hand analysis of the material rather than published images) need to be done. This typology could be used as a base for further analyses or comparisons.

The distribution of the ceramics analysed according to the forms is shown by fig. 2.

Bowls: It is important to note that bowls have been one of the most common ceramic forms throughout the Guadalquivir valley not only during the Bronze Age, but since Neolithic times. According to the distributions, bowls are the largest group among the forms. One of the issues regarding the analysis of bowls is the way they are described or classified. The ‘hemispheric bowl’ is a category that does not distinguish how much from the sphere the bowl takes. For this study, it was

decided to distinguish between the ellipsoidal and the real-spherical shapes and the different thirds or quarters of the sphere, and to separate the bowls according to these dimensions.

Fig. 3 shows the distribution of the bowls according to the types identified. Almost half of the bowls have been made following the sphere shape (48.9% n=188), with the carinated bowls following as the second most common type of shape (23.4% n=90), and the ellipsoidal bowls being the third most common (13.5% n=52) followed by the ‘V’ (8.6% n= 33) and ‘U’ (5.7% n=22) shapes. It can be said that this distribution follows the idea that the spherical and carinated are the most representative bowl shapes during the Bronze Age.

All bowl types are present along the whole valley as well as in each type of site (funerary, settlement or settlement with funerary contexts), supporting the idea that these recipients were useful for different contexts. From the 384 bowls, 94% (n=362) have no decoration, while the rest are mainly decorated with the so-called *mamelón* (n=14), a bump, generally in both sides of the bowl body, useful for holding the recipient. Other types of decoration are linear-digital marks along the rim (n=3), zig-zag incisions along the internal border (n=2), ‘bulges’ along the external border (n=2), handles (n=1) and reparation holes (n=1).

Orzas: The *orzás*, along with the globular vessels, are storage vessels for both liquids and grains. Fig. 4 shows the distribution of the *orzás* according to the types identified: Regarding the distribution of the *orzás* along the Guadalquivir valley, the parabolic and the everted neck types are not present in the Low Guadalquivir but are seen in the Middle and High Guadalquivir (see next section).

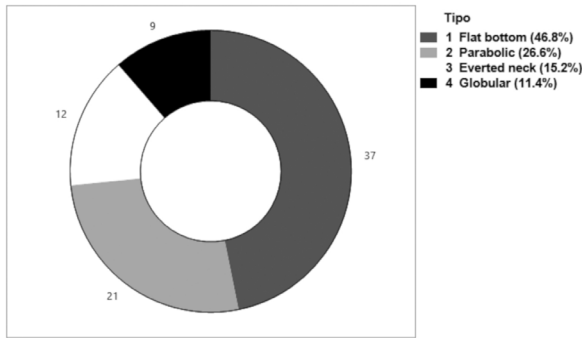


Fig. 4. Distribution of the *orzás* according to the types identified.

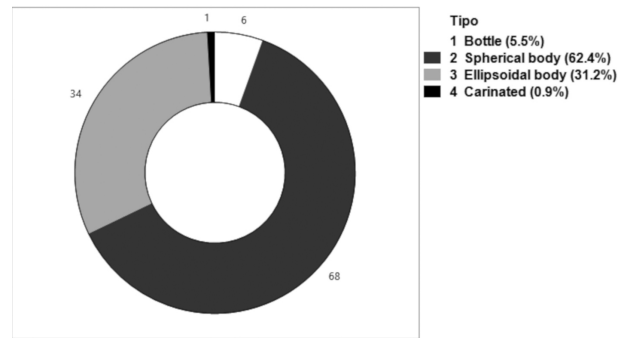


Fig. 5. Distribution of the types of globular vessels.

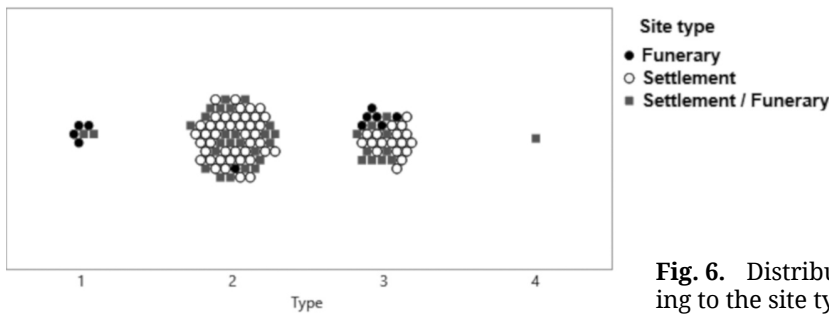


Fig. 6. Distribution of globular vessel types according to the site types.

From 79 *orzás* identified, only one was identified in a funerary site, the character of these vessels, according to this data, seems mainly domestic.

87% of the *orzás* (n=69) have no decoration. The rest show a distribution of linear-digital marks along the rim with 9% (n=7), handles below the border (1% n=1), incisions and dots forming triangles (1% n=1) and *mamelón* (1% n=1).

Tulipas: From the 24 *tulipas* identified, only one is present in the Low Guadalquivir, the rest are distributed in the Middle and High Guadalquivir valley (see next section). Regarding their distribution according to the type of site, again, only one is from a funerary site, while all the others are distributed between settlements, and settlements with funerary contexts. None have any kind of decoration.

Globular vessels: Fig. 5 shows the distribution of the types of globular vessels. The largest type is the spherical body, having again the sphere as one of the main referents in vessel shapes. The second largest is the ellipsoidal (with a body width larger than the height), then the bottles (vessels with a long neck) and only one carinated vessel. Fig. 6 shows the distribution of globular vessel types

according to the site types: From six bottles identified, four were found in funerary contexts, the other two were present in settlements with funerary contexts; however, these last two (the bottles from Chichina and Eras del Alcázar) belong to the funerary part of the complex (cist burials). It would be important to explore the possibility of having bottles exclusively as grave goods during the Bronze Age.

Spherical and ellipsoidal vessels are present both in settlements and settlements with funerary contexts (showing a more domestic character). The carinated vessel from Chichina is also part of the funerary part of the complex.

Cups: Cups have been one of the most representative ceramic forms for the Full Bronze Age. They have been associated to the presence or influence of the so-called 'Argaric territory'. However, the presence of this form in the Low Guadalquivir (see next section) challenges us to consider other ways of interpreting the spatial relationship between sites according to the ceramic distributions. Given the low number (n=6) of cups included in this study, it is more accurate to analyse them in the context of their spatial distribution.

3. Methodology

3.1. Analysis of Interactions between Sites According to the Types of Wares Shared

All ceramic forms have types, and some types also have subtypes, identified according to specific elements that facilitate the distinction of one piece from another (e.g. decoration, orientation of the border or shape of the rim). Subtypes helped to determine which ceramics were more similar (or identical) than others and to better organise the typology according to the matches found (*fig. 7*).

Every piece of ceramic has its respective site of provenance, meaning that there is a strong bond between any comparison made between ceramic pieces and the likely spatial correlations considered for them in the past. Departing from the first level of interpretation, it is possible to say that matches identified at the subtype level are evidence that these sites 'shared' at least the same type of pottery (*fig. 7*).

The word 'shared' implies that sites with a specific position in the Guadalquivir valley had people interacting during the Bronze Age. But beyond materials, they shared ideas, knowledge, values, costumes, and other resources that supported social life. Ceramic types are only a very small material expression of all the material and immaterial resources shared between people in the past.

From this typology, ceramics can also provide evidence of knowledge being shared between settlements. Such knowledge could have flowed in two different directions: first, by contributing to the local production of the same ware in different settlements, and second, as an end product distributed from one production site. These two possibilities can be assessed in a primary stage, through the archaeometrical analyses of some pieces collected from different sites.

The matches at the subtype level were useful also for calculating the proximity of the sites according to the coinciding types of wares used. The more matching subtypes found between two sites, the more shared knowledge and the more proximity (not in space but on a relational level) evident. In order to calculate such levels of proximity, a matrix of relationships was elaborated.

Every match identified between two sites was counted and transferred into a matrix that crossed the matches found between all 52 sites included in this study. The more general matches (at the level of forms or types for example) were excluded.

Counting the more specific matches helped to show interactions between sites according to similar ways of keeping or producing ceramics.

The matrix produced showed that some sites had more matches than others. Certainly, sites with larger amounts of ceramics excavated and published are going to have more matches. However, such matches, more than measuring, are mainly showing interactions between settlements based on one type of information, in this case, ceramics. It is possible to generate matrixes with coinciding types of data, such as types of metal artefacts, types of funerary sites, or any other comparable aspect.

All these matrixes at the end would show the same outcome: that people interacted, moved between sites and shared resources. This is one of the main goals of this approach: showing that the Middle and Low Guadalquivir valley regions were not empty, but had people living in them, moving between them and interacting with other groups in southern Iberia. Typologies, and the subsequent models made from them, are used here not for delimiting a territory but for generating awareness that space in the past was perceived in a different way. This method of showing spatial interactions in the past is not achieved through inventing arbitrary borders or arrows, but through using the provenance of all the material record or data obtained to generate models that explain the flow of material and immaterial resources in the landscape. This produces something that is more verifiable in reality than a 'territorial' map.

In order to better visualise the results obtained by the matrix, it was processed with a software for social network analysis. This software produced a graphic representation of the proximity of the sites according to the number of matches found between them (*fig. 7* and *8*). The resulting network of interactions showed which sites shared more ceramic subtypes with others, but at the same time demonstrated how all of them were interconnected and how knowledge flowed between them. Despite this model being elaborated with a

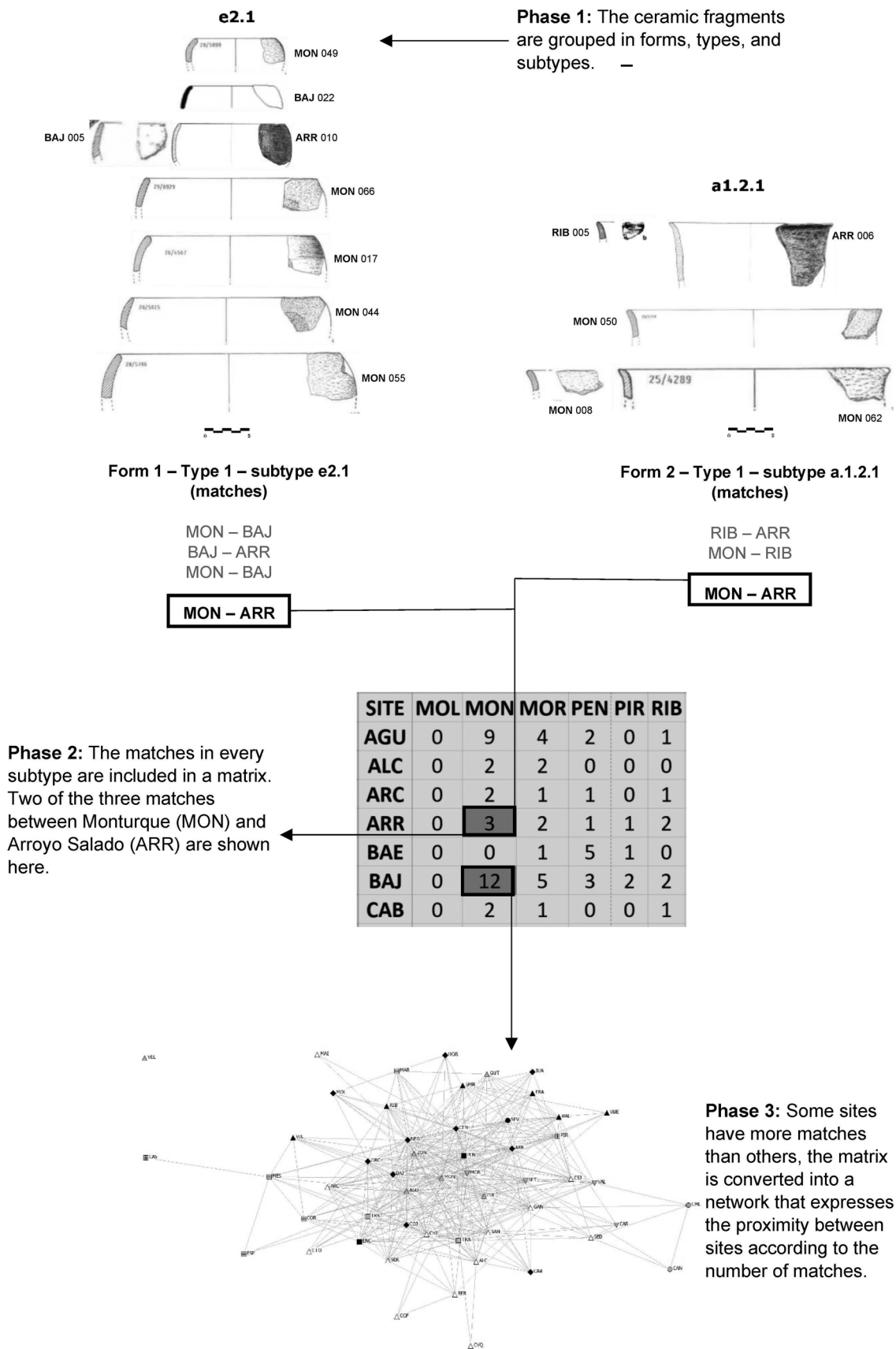


Fig. 7. Phases for identifying the level of interaction between sites according to the wares used.

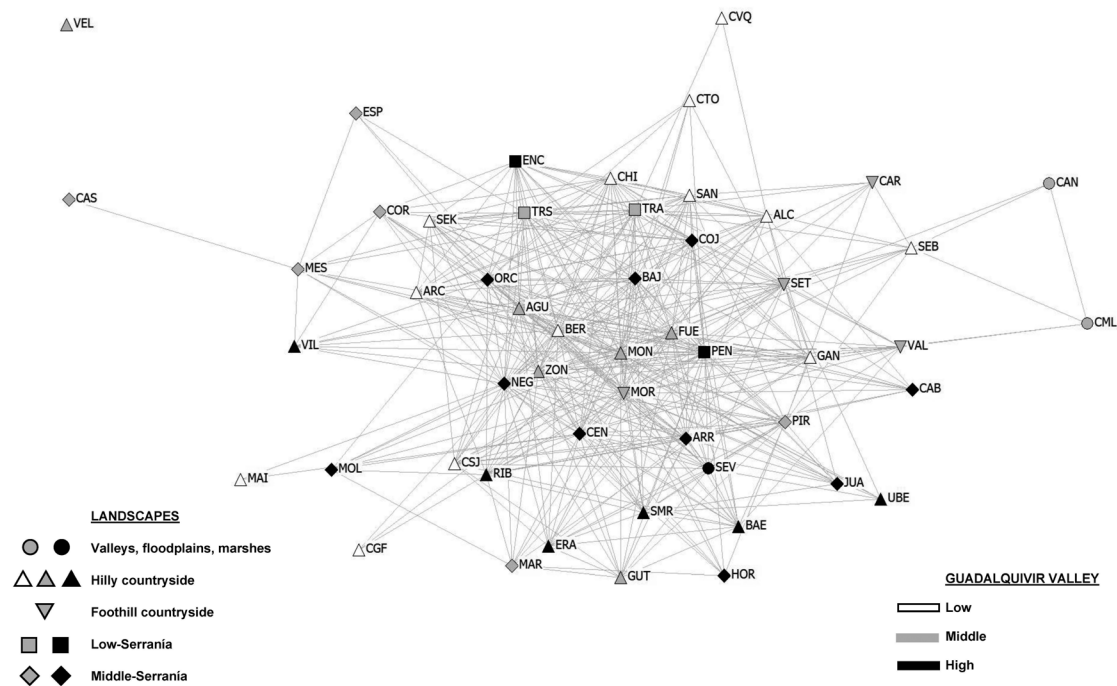


Fig. 8. Network of interactions between sites according to the number of matches in the ceramic subtypes (Borgatti et al. 2002, 12).

ceramic typology, the network obtained provides evidence that along with this material, many other resources were circulating and linking the region. Cartographic representations of such interactions can represent the flow of people, animals, material and immaterial resources during the Bronze Age.

After obtaining the network, the software allows for the customisation of the nodes with additional information that helps to better interpret the interactions shown. The nodes in the network were customised according to two criteria:

- Colour coding the regions of the Guadalquivir valley where the sites are located (*fig. 8*):
 - Low in white
 - Middle in grey
 - High in black
- Organising by shapes the geographical landscapes identified by the Andalusian Agriculture, Fishing and Sustainable Development Council (Junta de Andalucía 2020) (*fig. 8*):
 - Valleys, floodplains and marshes (circle)
 - Hilly countryside (upper triangle)
 - Foothill countryside (down triangle)
 - Low-Serranía (square)
 - Middle-Serranía (diamond)

Colours and shapes were assigned to every site according to the criteria mentioned above.

According to the disposition of the sites in the network, it is possible to see how the three regions of the Guadalquivir valley are all interconnected. There is a larger number of Middle and High Guadalquivir sites clustered at the centre of the network, showing that they have more matches between them than with the Low Guadalquivir sites. However, the central position of Cerro del Berrueco (BER) shows that this Low Guadalquivir site in specific, could have had more interactions and exchanges with other regions.

Sites in the Low Guadalquivir are also clustered with some others in the Middle and High valley, showing the matches that indeed exist between these regions (e.g. the proximity between Cerro del Berrueco [BER], Orce [ORC] and Castillo de Aguilar [AGU]). These are sites very distant from each other geographically but with similarities in their pottery according to the matches found. The sites most distant from the centre are sites with a lower number of ceramics to compare and should not be misinterpreted as indicating distinct pottery types.

Regarding the types of landscapes, all the Low Guadalquivir valley sites are set in the hilly countryside, taking advantage of the slight elevations next to big water bodies, such as the ancient Lacus Ligustinus. The countryside and the *serranía* (with settlements at the foothills of the Sierra Morena or the Baetic System) are very close to each other, in terms of matches between the types of ceramics identified.

The landscape types distributed along the network confirm a trend observed in other sites during the Bronze Age in southern Iberia; hilly and mountainous areas were preferred for settlements, with only three sites located on the floodplains.

The resulting network of interactions was combined with a Geographical Information System (GIS) to complement the matches observed, and especially to observe their spatial expression.

3.2. Analysis of Spatial Distribution of the Ceramic Types along the Guadalquivir Valley

Typologies have been the fuel for cultural historical approaches. Generally, under this approach, ceramic typologies are subscribed to a territory delimited by the archaeologist, defining an identity for the people and the space that is described. They have also been useful tools in organising the material record and finding links between different sites or regions.

Interpreting the material record sometimes requires deciding the way these interactions between people are going to be described. Some matches are associated with ‘influence’, others with ‘invasion’. The accurate definition of the character of these interactions depends on the integration of other types of data.

The Guadalquivir valley is problematic by having some areas understudied for the Bronze Age (Bartelheim et al. 2021). Most of the findings have been associated with the ‘influences’ of the ‘Argaric territory’ or the Southwestern Bronze in these regions; however, neither the distribution of types, nor the regional links between them have been clear. The claims regarding these connections only care about the interactions between the site introduced or described in the publication

and the territory with which it is associated or linked.

The methodology presented here intends to give an alternative perspective for the treatment of the material record along the Guadalquivir valley. The typology elaborated does not integrate a new delimited ‘territory’ nor has its own ‘identity’ against other territories as El Argar. The purpose of this typology goes even beyond considering any ‘acculturation’ or ‘territorial expansion’ that has not been properly proved for the Full Bronze Age.

This typology is just the first step of a spatial analysis that intends to show the flow of information, ideas and people in the south of the Iberian Peninsula during this period. As mentioned above, GIS helps to show the spatial expressions of this flow. GIS is also a very useful tool for understanding and describing landscapes from the past; it helps to go beyond the classic cartographic representation of a delimited map of a territory with an identity based only in its material record. GIS also helps to spatially organise the different resources identified along the landscape as well as the ways they interact. This is the procedure followed:

- For the Guadalquivir valley, a Digital Elevation Model (DEM) from the Junta de Andalucía’s mapping service was downloaded. DEM’s are raster maps that contain height information for a set of pixels arranged along the earth’s surface that intends to be represented. Each pixel has information on the height above sea level across the area defined for the map (Conolly/Lake 2006). In this case, the model contains information of the elevations along the Guadalquivir valley and the surrounding mountains in the Sierra Morena and the Baetic System.
- The DEM was inserted into the GIS and the percentage of slope on the terrain was calculated from the DEM with one of the tools provided for the GIS for raster analyses, giving as result a new raster map with information of the percentage of slope in every pixel. This slope layer contains relevant information for calculating the cost of movement between two points across the surface.
- After inserting a third layer in the GIS, with the location of the 52 sites included in this



Fig. 9. LCPs network between the 52 sites, calculated according to the matches in their ware. The slope map layer is in the background, its colour gradient was inverted (now white represents the lowest elevation [0 m.a.s.l]) to facilitate the view of the other layers. © QGIS 2020.

study (*fig. 9*), the least cost path (LCP) between pairs of sites was calculated. LCPs represent a hypothetical route that goes across the surface, following the easiest path between two points, that means the path with less accumulated cost-surface (Conolly/Lake 2006), or in other words, the path that avoids the surfaces with the highest positive slopes.

The criteria for deciding which sites were going to be linked through LCPs was based mainly on the matches found during the elaboration of the ceramic typology. All the LCP's elaborated composed a vector (lines) map with a hypothetical network that helped to show the high spatial interaction between the different regions along the Guadalquivir valley.

Both networks, the one elaborated in the GIS and the graphic, are different ways of representing interactions between sites. However, whereas the one made with LCPs expresses spatially these

interactions, the graph expresses which sites are more related than others.

Despite giving a representation of spatial interactions, the LCP network is not enough evidence of spatial links between sites in the real terrain, it was necessary to find evidence of real routes. One way of solving this issue was including new layers with vector maps of the current livestock routes in Andalusia. These vectors (lines) were crossed with the ones the LCP network produced to see the intersections between the two types of information (*fig. 10* and *11*).

It is important to note that migratory herding has been implemented in the Guadalquivir valley since at least Iberian (pre-Roman) times (Klein 1985). The knowledge and use of these routes has even been documented by Romans (Blanco 1999) and today most of these ancient routes are still in use and are very important for the mobility of cattle and ovicaprids across the Guadalquivir

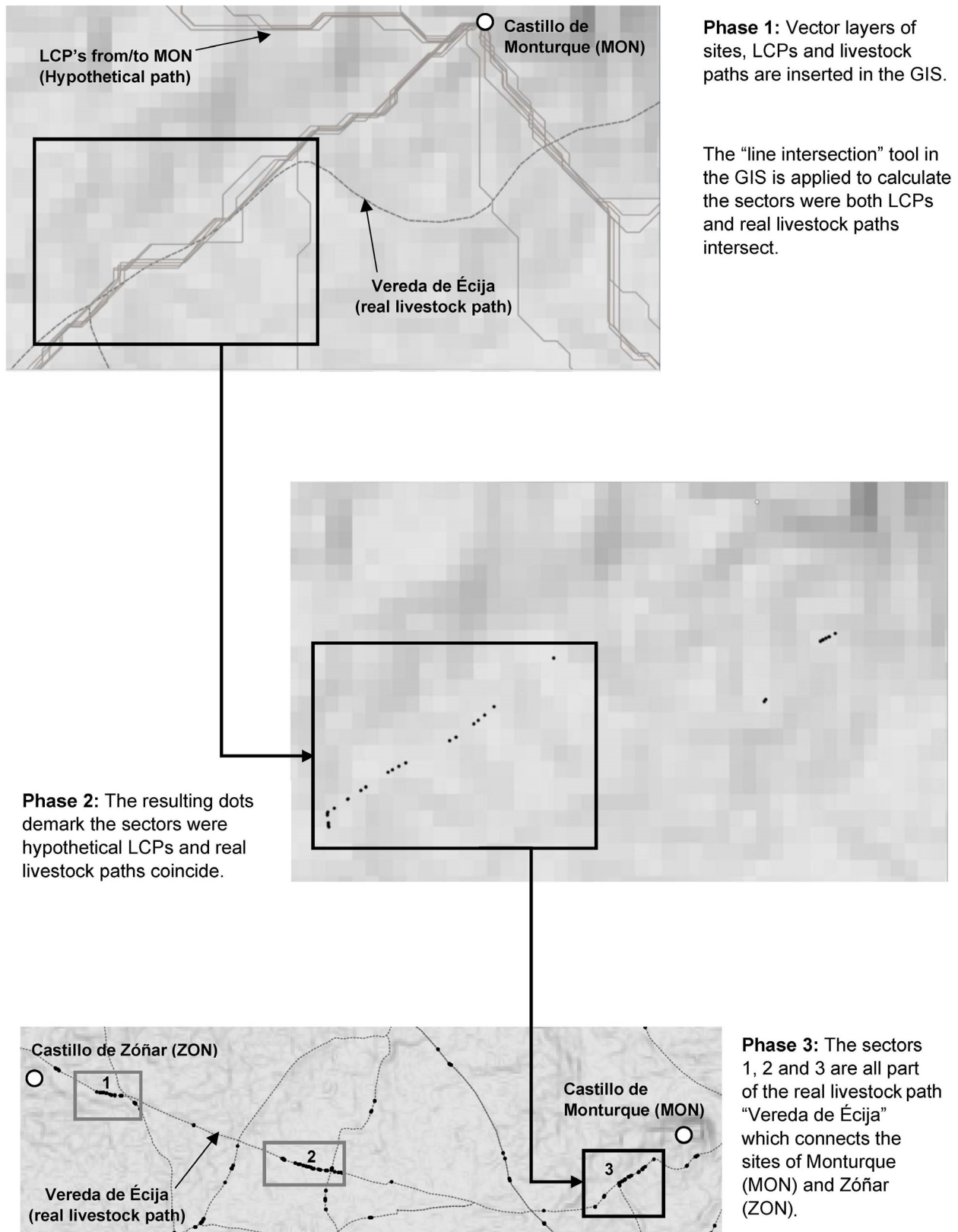


Fig. 10. Phases for identifying real connections between Bronze Age sites.

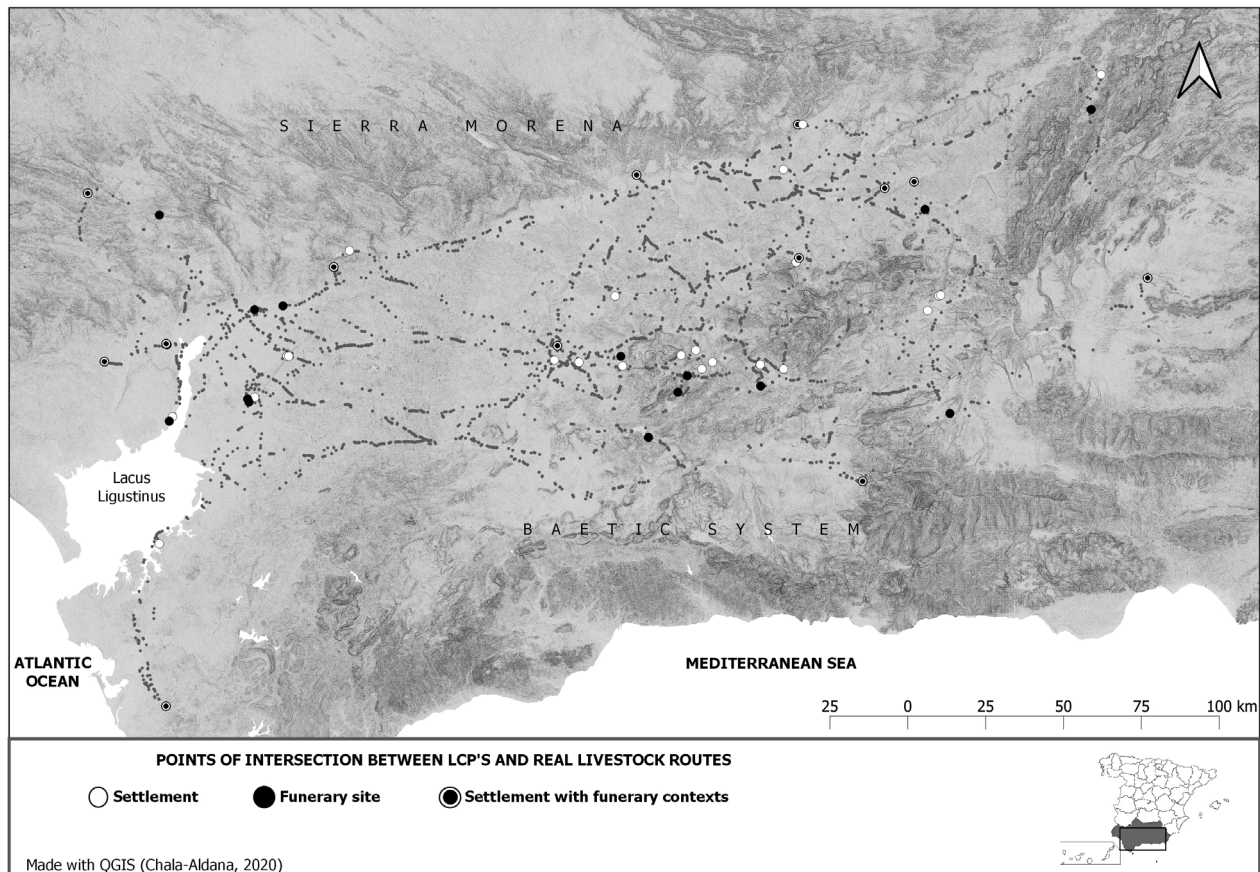


Fig. 11. Intersections between LCPs and real livestock routes. Points on the map are the Bronze Age sites included in this study. Their positions and names are the same as the ones displayed in fig 1. Numbers were removed to emphasise the intersection points.

valley and beyond, being finally another component of the landscape (Caballero Cobos 2014). Additionally, herding of ovicaprids has been also documented during the Chalcolithic and the Bronze Age (Murrieta Flores et al. 2011a; 2011b; Wheatley et al. 2010).

There are four types of livestock paths according to their size (Blanco 1999):

- *Cañadas*: paths with a width that does not exceed 75m.
- *Cordeles*: paths with a width that does not exceed 37.5m.
- *Veredas*: paths with a width that does not exceed 20m.
- *Coladas*: paths with a width lower than 15m.

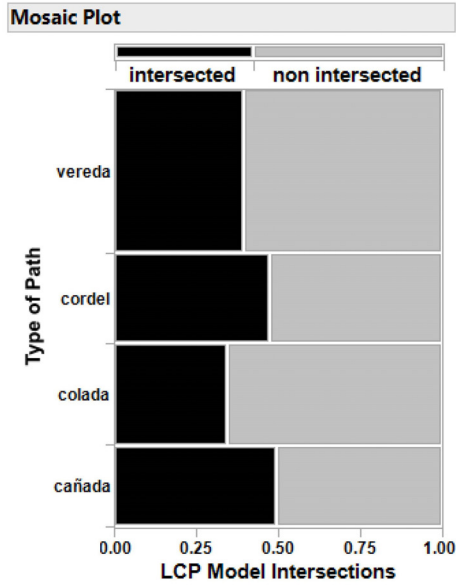
The vector map with the livestock routes (mapped from the real terrain) was downloaded from the website of the Junta de Andalucía mapping service. The metadata (information) that comes with the vectors allowed to classify the paths according

to each one of the four types known. Each type of path was differentiated, and every single path was counted, to know how much of them were intersected by the LCP network.

After running the algorithm for intersecting both the LCPs and the livestock paths, the resulting map showed a series of points marking the sectors where both LCPs and livestock paths intersect (*fig. 11*). Most of these intersections were not perpendicular but followed the same direction as the real path (*fig. 10*). Pearson's χ^2 test was performed to check if the theoretical model resulting from crossing LCPs and livestock paths arose by chance or not (*fig. 12*).

According to the results of the Pearson's χ^2 test, the model produced with the GIS is far from being a product of chance, which means that the links made between pairs of sites, based on the matches in their wares, can be spatially represented in the real livestock routes that exist today along the

Contingency Analysis of LCP Model Intersections By Type of Path



Contingency Table

Type of Path	LCP Model Intersections		Total
	intersected	non intersected	
cañada	197	199	396
colada	172	320	492
cordel	208	228	436
vereda	315	476	791
Total	892	1223	2115

H₀: There is no dependence between LCP model intersections and the real livestock paths, in other words, that the theoretical model resulting from crossing LCPs and livestock paths arose by chance.

H₁: There is dependence between the LCP model and the real livestock paths, which means that the theoretical model did not arise by chance.

Tests

	N	DF	-LogLike	RSquare (U)
	2115	3	13.564862	0.0094

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	27.130	<.0001*
Pearson	27.079	<.0001*

The distribution of the least cost paths (LCPs) across real livestock types differed significantly from random (Pearson's $\chi^2 = 27.079$, $df=3$, $N=2115$, $P<0.0001$)

→ H₀ Rejected.

Fig. 12. Pearson's χ^2 test between theoretical LCPs model and real livestock routes.

Guadalquivir valley. Considering that livestock paths have been used since pre-Roman times, with the calculations made it is not difficult to think that their origin can be even more ancient, possibly reaching back to prehistoric times. In the end, Bronze Age people had to move through the same space, moving with them objects, herds and cattle, and likely these livestock paths are the result of thousands of years of the same practice.

The advantage of identifying the real routes connecting Bronze Age sites is that most of them could also provide new possibilities for future surveys around these paths, increasing the probability of finding other undiscovered Bronze Age sites in a region that needs to be properly surveyed.

4. Corridors Identified

According to the model obtained, there are several corridors linking different corners of southern Iberia (fig. 13). These are the main ones:

- Corridor 1, Guadalquivir Route: This route follows the whole course of the Guadalquivir river, starting from the High Guadalquivir in the region around Úbeda and leading in western direction, always following the river until its ancient mouth next to Coria del Río. This route is the 'backbone' that connects the southeast with the southwest. Likely, this route was complemented by the use of the river itself as traffic route (fig. 13: dark blue line).

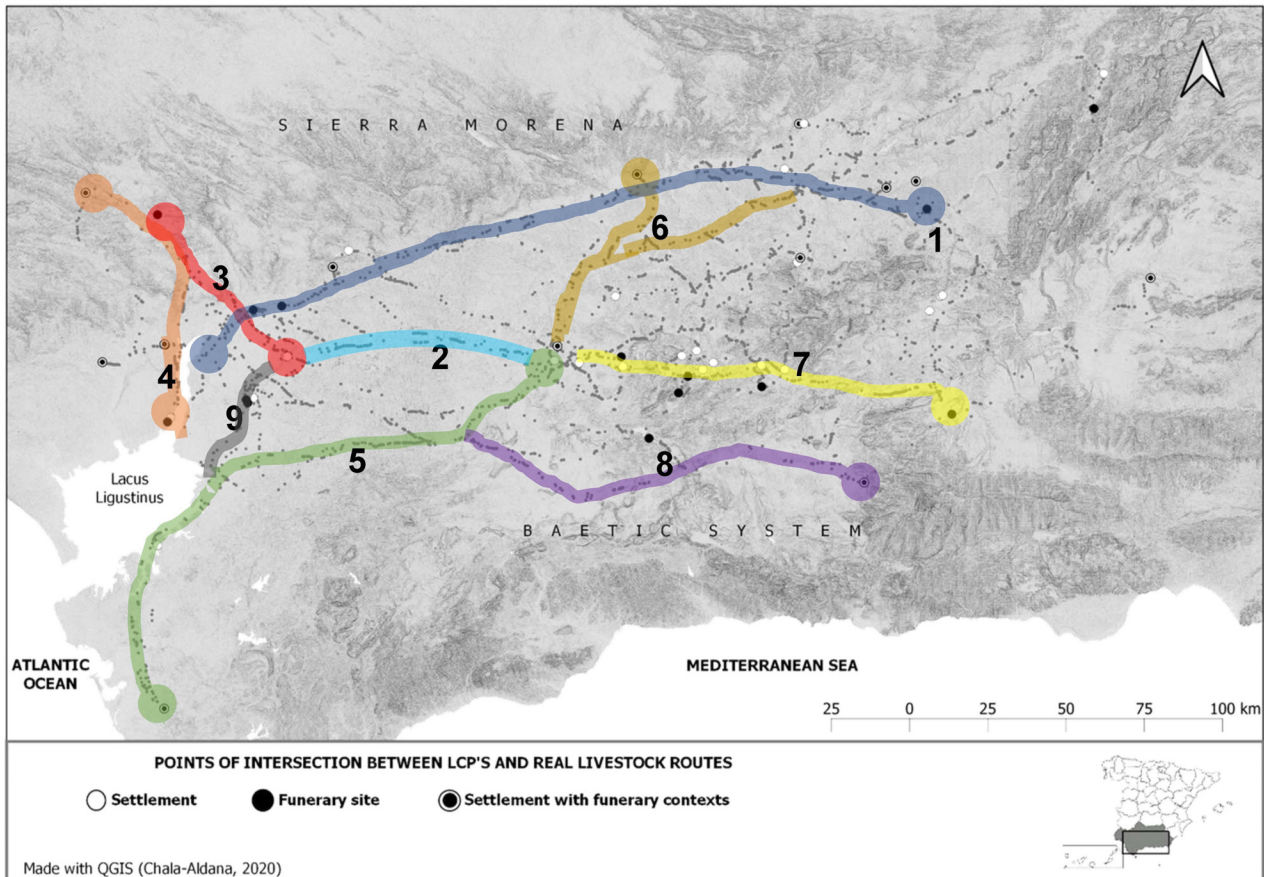


Fig. 13. Routes along the Guadalquivir valley identified from the livestock routes crossed with the LCPs model.

- Corridor 2, Campiña–Los Alcores Route: This route starts from the south of the countryside of Córdoba, next to the sites of Monturque (MON) and Castillo de Aguilar (AGU). It leads in a northwest direction by the ‘Colada de Fuente Vieja’ connecting with the *vereda* from Écija to Lucena. Then it turns west along the ‘Cañada real de Don Francisco’ and the ‘Cañada real de la Carretera a Madrid’, until connecting with the ‘Cordel de la Vereda de la Venta de la Portuguesa al Mirador’, which arrives in the Los Alcores region in today’s Carmona next to the sites of Plaza de Santiago (SAN) and Calle Torre del Oro (CTO) (fig. 13: light blue line).
- Corridor 3, Los Alcores–Riviera del Cala Route: This route starts from the Los Alcores region. It leads northwest by the ‘Vereda de Cantillana’, crossing the Guadalquivir and reaching the ‘Volada de Burguillos’. It connects with the ‘Vereda del Barranco del Infierno’, until reaching the riverside of Cala in the Sierra Morena, next to the sites of El Trastejon (TRS) and La Travesía (TRA) (fig. 13: red line).
- Corridor 4, El Aljarafe–Riviera del Cala Route: This route starts next to the sites of Cerro de San Juan (CSJ) and Cobre las Cruces (SEK–SEB). It leads in northern direction by the ‘Colada del Camino de Palomares a Sevilla’, then follows a section of the ‘Cordel de la Vereda de Campogaz’ until reaching the ‘Vereda de Guillena a Castiblanco’ following the same path as the ‘Vereda de Sevilla y Guillena’ until the ‘Vereda del Barranco del Infierno’, conducting as the corridor 3 to the riverside of Cala (fig. 13: orange line).
- Corridor 5, Campiña–Atlantic Coast Route: This route starts from the countryside of Córdoba going in a southwest direction by the ‘Cañada de Granada’, connecting with the ‘Cañada real de Marchena a Estepa’ before reaching the ‘Cañada real de Morón’, where the path turns west. The path links with the ‘Vereda de

Herrera’, ‘Cordel de Barros’ and ‘Cordel del Gallego’ until reaching the eastern coast of the Lacus Ligustinus. Here it turns in a southern direction by the ‘Cañada de Sanlúcar a Sevilla’, the ‘Cañada de Lebrija’, ‘Cañada de Guadabajaque, Corchuelo y Moro’, ‘Cañada de Cadiz’ and ‘Cañada real del camino de Paterna’ until reaching the ‘Cañada real del Camino de Medina Sidonia’, next to the site of Cerro del Berrueco (BER) (*fig. 13*: green line).

- Corridor 6, Campiña–High Guadalquivir Route: This route starts at the countryside by the ‘Vereda de Mora’, turning north by the ‘Cordel del Cortijo del Rey’, following the path by the ‘Vereda de Los Limones’, the ‘Vereda de Córdoba a Cabra’ and the ‘Vereda de Montilla a Bujalance’. Then it takes the ‘Vereda de Castro a El Carpio’ until the ‘Cordel del Camino de Córdoba’, where the path turns to the east, until the ‘Colada de Los Almendros’, reaching the site of Llanete de los Moros (MOR), and from there, connects with the Guadalquivir Route until the High valley (*fig. 13*: light brown line).
- Corridor 7, Campiña–Guadix Route: This route starts at the countryside by the ‘Cordel de la Fuente del Chorrillo’ going east by the ‘Cordel de Doña Mencia a Carcabuey’, ‘Cordel de Córdoba a Granada’, ‘Cordel de Baena’, ‘Vereda de Martos’, ‘Colada de Frailes’, ‘Cordel de Jaén a Trujillos’, ‘Cañada real de la Atalaya de Cogollos’ and ‘Cañada real de Bogarre’ until reaching the ‘Cañada real de Iznalloz a Guadix’ and entering to Guadix and Baza valleys (*fig. 13*: yellow line).
- Corridor 8, Sierra Nevada–Atlantic Coast Route: This route starts from the foothills of the Sierra Nevada, next to the site of Cerro de la Encina (CEN). It leads west by the ‘Vereda del Camino de Los Abencerrajes’, ‘Colada de Las Calesas’ and ‘Colada del Hoyo’ until reaching the ‘Cordel de Montefrío’, which connects with the ‘Cañada real de Sevilla a Granada’, ‘Cordel de Santillán a Molina y Málaga’, ‘Cañada real de Sevilla a Antequera’, ‘Vereda del Ventorrillo del Chacho a Fuente de Piedra y Antequera’, and ‘Cañada real de Granada a Sevilla’, until reaching the ‘Cañada real de Morón’, which follows the same path as Route 5, from the same point until the Cerro del Berrueco (BER) site (*fig. 13*: purple line).

- Corridor 9, Los Alcores–Atlantic Coast Route: This route starts in the Los Alcores region, following the ‘Vereda de las Ventas de Sevilla’ southwest, turning to the south at the ‘Cordel del Término y de la Camorra’ and ‘Cordel de Mairena’, until reaching the coast of the Lacus Ligustinus by the ‘Cañada real de la Armada’ and ‘Cañada real de Utrera a Jerez’, finally linking with the ‘Cañada de Sanlúcar a Sevilla’ and following the same path from here, until the site of Cerro del Berrueco (BER) (*fig. 13*: gray line).

After verifying that the model obtained can be used for representing prehistoric paths linking Bronze Age sites, the next step was generating a spatial representation of the interactions between sites for each ceramic subtype identified. Representing such interactions by only displaying lines (prehistoric paths) connecting dots (Bronze Age sites) ignores the space surrounding them, as well as underestimates the ability of ancient human groups to move through the landscape.

One way of cartographically representing the movements of people through the landscape is by generating ‘archaeotopograms’ (Wilkinson 2014). Such models use ‘cost-surface’ analysis to display the flow of people and resources along a region. Basically, archaeotopograms calculate the costs of moving in any direction from a determined point (or group of points) to determined resources. They are elaborated using not only the information of the terrain (i.e. elevation and slope) but also the time and velocity (energy spent) by walking (*fig. 14*). Cost-surface analysis uses the simple Euclidean distances in the study area for assessing the effects of topography (slope) and terrain (land cover) on movement in a landscape (Ejstrud 2005), providing a raster map with a gradient that expresses, in colours, the effort and energy spent according to distance, slope and land surface of the study area. The redder, the higher the cost in energy/time necessary to reach that region.

Archaeotopograms were elaborated for each group of sites sharing the same ceramic subtypes (*fig. 16–26*). The resulting raster map showed the areas most accessible by walking as well as the space of interaction between sites. The space of interaction represents the areas where movement costs are lower and the chances for interactions

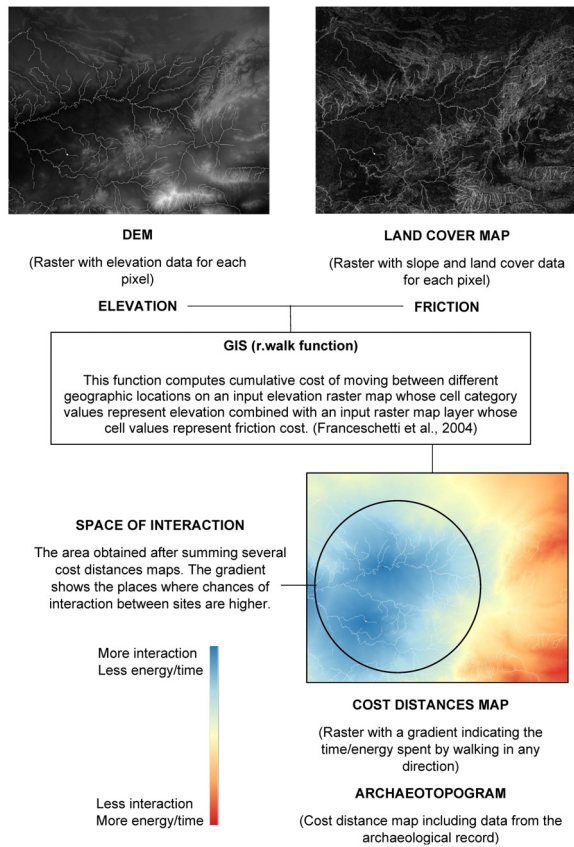


Fig. 14. Process of elaboration of an archaeotopogram.

between sites are higher. Such interactions are based on the knowledge around the ceramic made or kept. However, as mentioned above, along with ceramics, many other material or immaterial resources could have flowed inside this space.

Despite one archaeotopogram being elaborated for each ceramic subtype identified, it was also necessary to have a chronologic control for the information obtained. The ceramic subtypes from the sites with radiocarbon dates (*fig. 15*) were grouped and their respective rasters were summed. Using the ‘raster calculator’ tool in GIS, the costs of all the archaeotopograms grouped under the same chronology were summed. The sum of rasters helped to define a definitive archaeotopogram, showing the space of interaction between sites for the span of time confirmed with radiocarbon dates.

Whereas one subtype-based archaeotopogram shows the costs of movement along the landscape and the space of interaction between the sites

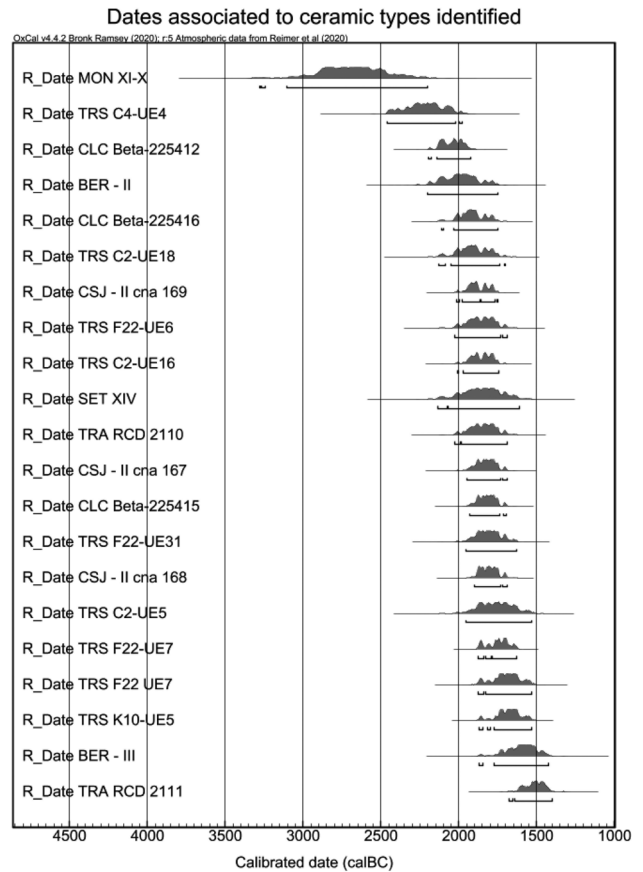


Fig. 15. Radiocarbon dates from the sites used for elaborating archaeotopograms.

involved, the sum of several of them also shows the degree of interaction based on the costs summed. The darker the blue, the higher the degree of interaction in such area.

To the resulting ‘chronologically controlled’ archaeotopogram, the model of prehistoric paths was added to define the routes where people, livestock, and knowledge about ceramics, along with other material and immaterial resources, could have flowed.

5. Archaeotopograms and Ceramic Distributions

Monturque (MON)

Despite the only radiocarbon date for the strata XI-X being obtained in the 1980s and having a very high ± deviation, it could still provide some clues about the chronological situation of the

ceramic groups identified for each layer. Monturque has levels with Chalcolithic and Bell Beaker pottery without any *hiatus* or break along the sequence after them, showing an apparent continuity in the occupation of the site for the transitional Copper-Bronze Age (López Palomo 1993).

The Bronze Age pottery, distinguished by the absence of decoration and the burnished treatment of the surface (López Palomo 1993) lies in level 33 of stratum X, levels 28 to 32 of stratum IX, and 24 to 27 of stratum VIII. The ceramic subtypes identified, and the sites sharing them with Monturque, are seen in table 2.

The space of interaction for stratum X of Monturque (*fig. 16*) shows a more intense blue gradient towards the High Guadalquivir valley, as well as the Guadix and Baza valleys. Most of the ceramic subtypes are shared with sites coming from these regions, such as Marroquíes Bajos (twelve subtypes), Cerro de la Encina (13 subtypes) and Llanete de los Moros (15 subtypes). However, the amount of coinciding subtypes with other sites is enough to consider that the interactions may have occurred along the whole Guadalquivir valley.

Mobility from the countryside (where Monturque is located) was possible using several corridors that connected practically with any corner of southern Iberia (*fig. 13*). The gradient turns red towards the southeast; however, this is because the sites included in this study are restricted to the Guadalquivir valley. Having some so-called Argaric sites in the blue gradient next to Monturque implies that the blueish trend would continue through any site in the southeast, sharing the same pottery as sites such as Cerro de la Encina (CEN) or Peñalosa (PEN), if it was included.

The trend basically continues for the strata IX (*fig. 17*) and VIII (*fig. 18*), meaning that the interaction of the countryside with the whole of southern Iberia was continuous.

Some subtypes seem to only be present in the site of Monturque, or at least, no types were found that coincide with any other site. These were the exclusive subtypes found in Monturque:

- Level 33:
 - One third of a sphere carinated bowl (Form 1, Type 7, Group a4).
 - *Orza* with a slightly divergent neck (Form 2, Type 3, Group a1.4).

- Level 32:
 - (*) Half of a sphere bowl with a slightly everted lip (Form 1, Type 4, Group d).
 - *Orza* with straight neck (Form 2, Type 2, Group a2.3).
 - *Orza* with everted neck and cylindrical body (Form 2, Type 3, Group a1.3).
- Level 31:
 - *Orza* with everted neck (Form 2, Type 1, Group b2).
- Level 30:
 - One third of a sphere bowl with an edge along the internal rim (Form 1, Type 3, Group a1.9).
 - ‘V’ shaped bowl with flat rim (Form 1, Type 10, Group a1.3).
 - (*) *Orza* with divergent body (Form 2, Type 1, Group a2.2.2).
- Level 29:
 - (*) ‘U’ shaped bowl with a slightly everted rim (Form 1, Type 11, Group g).
 - *Orza* with broadened rim (Form 2, Type 1, Group a1.3).
- Level 28:
 - One third of a sphere bowl with everted lip and flat rim (Form 1, Type 3, Group b3).
 - Globular vessel with divergent lip (Form 4, Type 2, Group c2.4).
 - Globular vessel with broadened and divergent lip (Form 4, Type 2, Group c2.6).
- Level 27:
 - One third of a sphere bowl with bent (divergent) body (Form 1, Type 3, Group c).

Having such a large amount of exclusive ceramic types along the whole Bronze Age sequence of Monturque could correspond to a local production with autochthonous forms, supporting some models explaining a ‘cultural autonomy’ of this countryside region against the Argaric influences that, still, are also present in its material record. However, it is important to note that at least three of these subtypes here listed, the ones with the asterisk (*), are present in the western peninsula, reaching even the Alto Vouga and Alto Paiva regions (Senna Martinez et al. 1984). Such coinciding subtypes are indicative of long-distance interactions beyond the Guadalquivir basin, through the same routes as the ones used by several Sierra Morena populations to access to the Guediana valley, for example.

S	Level	Form	Type	Sub	Coinciding Sites										
VIII	26-27	1	3	a1.1	TRA	VAL	ZON	CEN	ALA						
	26	1	4	a2.2	SMR										
	26	1	8	c	AGU	MOR	SET	SEV	SMR	UBE	ALA				
	25	1	3	a1.2	ZON	ORC									
	25	1	7	1.2.2	SEV	ALA									
	25	1	8	e3	BAJ	FUE	SET	SEV							
	25	1	10	a1.1	BAJ	JUA	MOR	PEN	RIB	SMR	BER	ALA	NEG		
	25	2	1	1.2.1	ARR	RIB									
	25	4	3	a1.2	CHI	FUE									
	24-27	4	3	a1.1	AGU	BAJ	VIL	ZON	ORC						
	24-25	1	6	b	AGU	ARR	BAJ	ZON	BER	ALA					
	24	1	3	a1.3	CHI	FUE	ZON	TRS	NEG						
	24	1	10	a1.4	TRA										
	24	4	2	a4.3	CGF	MOR	BER								

Table 2. Groups of sites sharing the same ceramic subtype by each stratum (S) and level of Monturque (MON). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

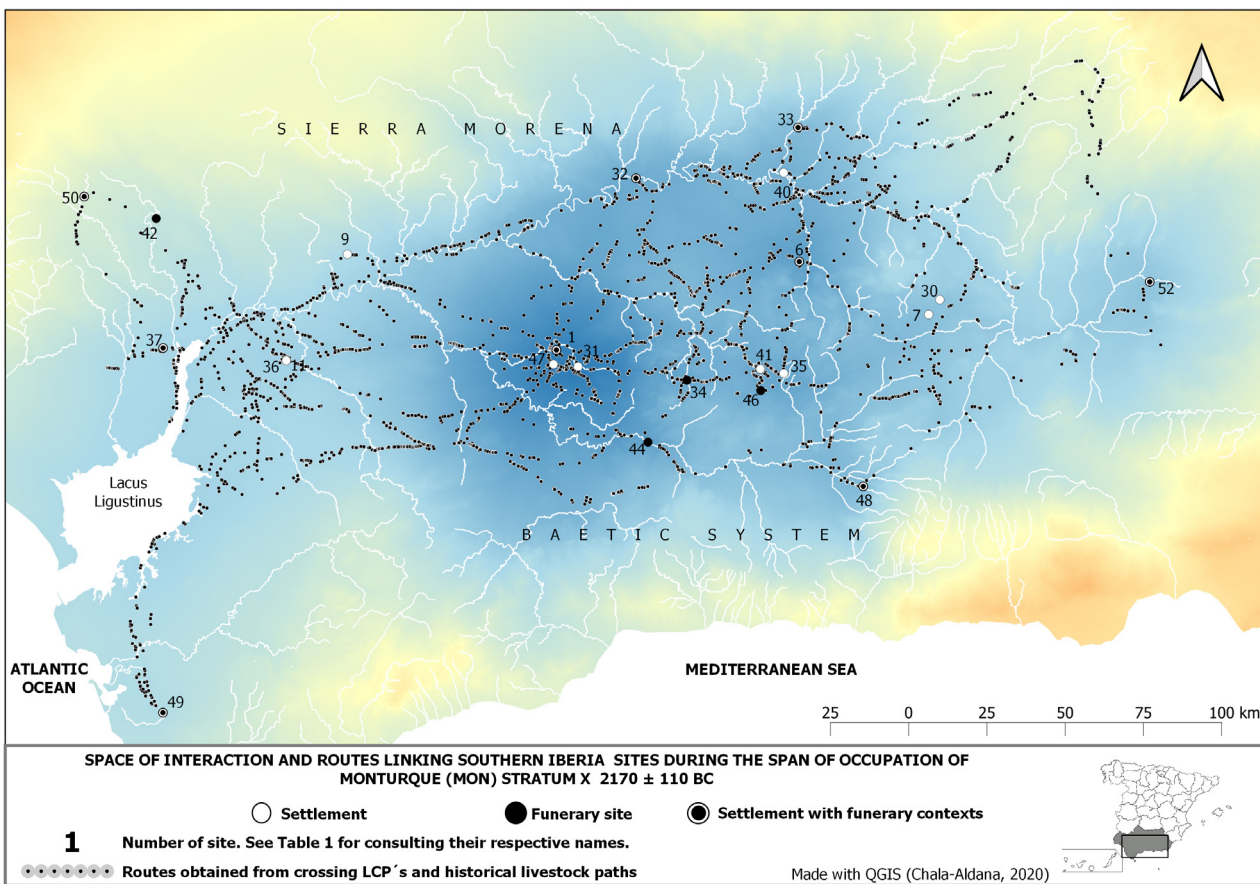


Fig. 16. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Monturque (MON) (31) Stratum X.

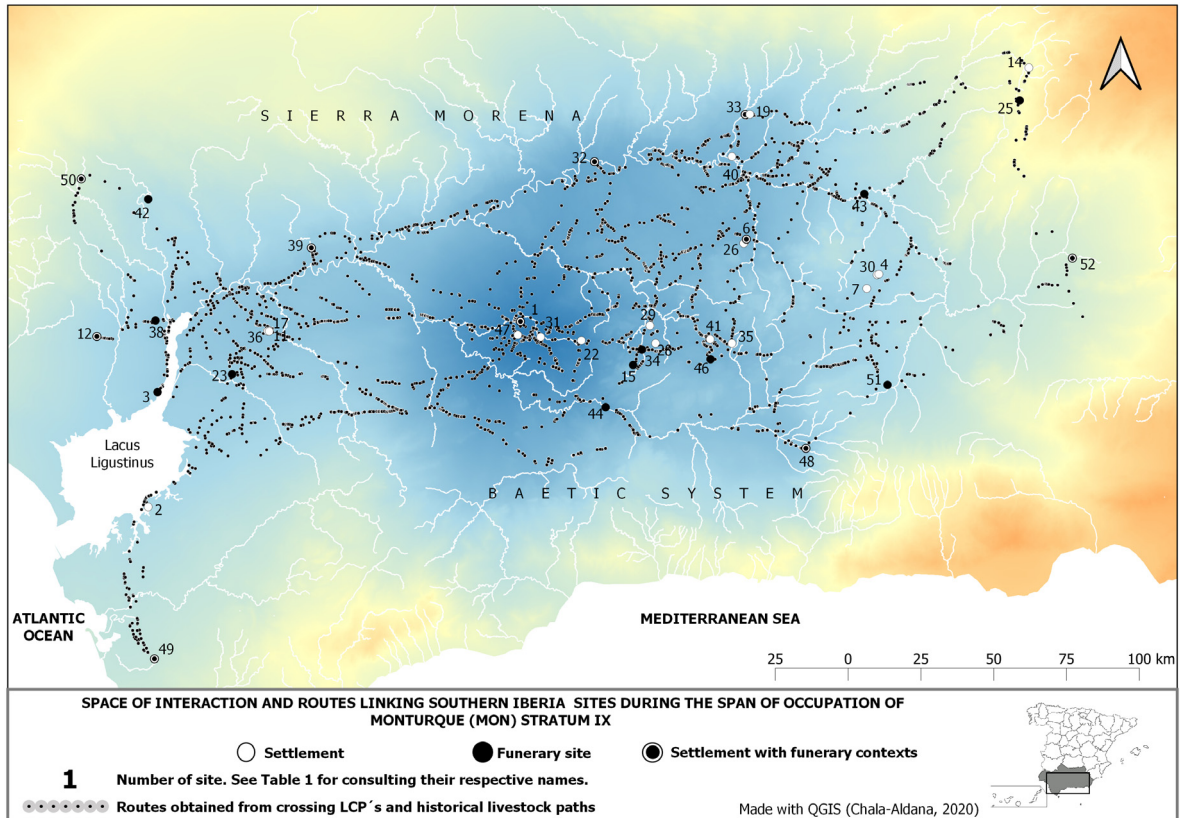


Fig. 17. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Monturque (MON) (31) stratum IX.

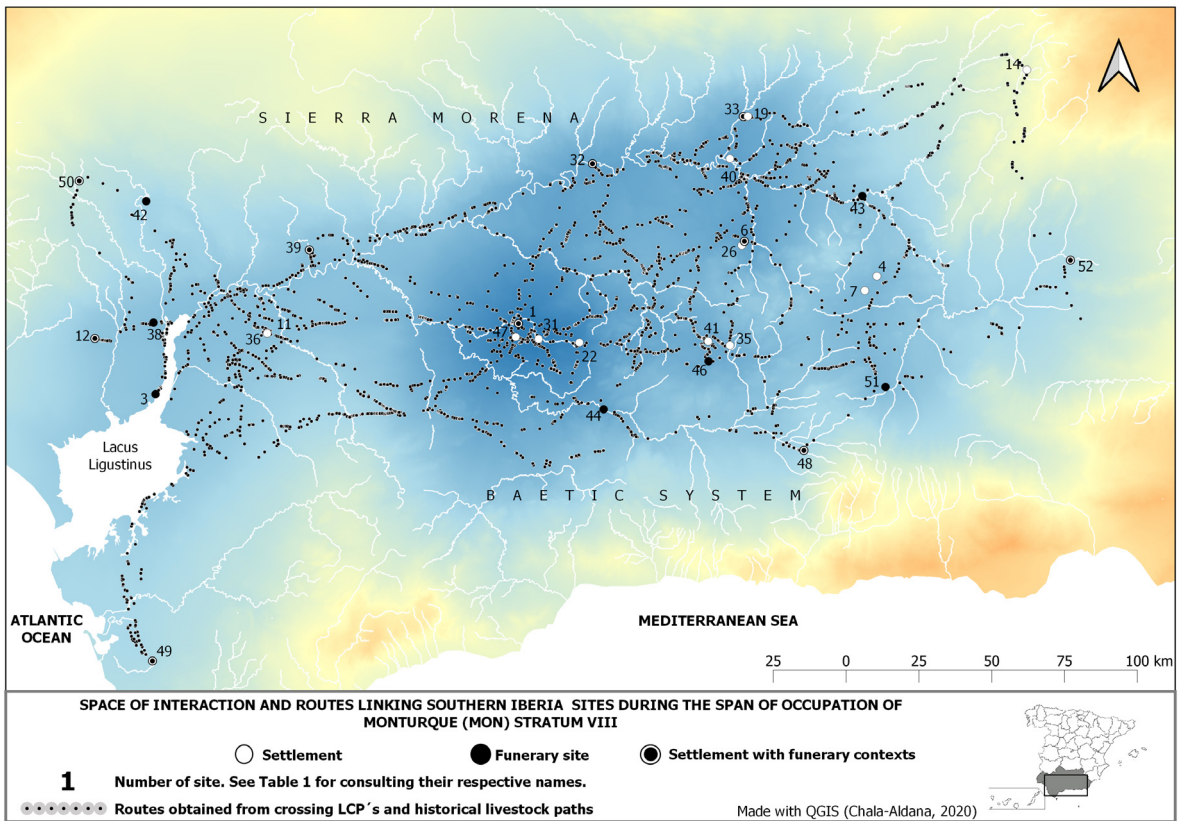


Fig. 18. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Monturque (MON) (31) stratum VIII.

S	Level	Form	Type	Sub	Coinciding Sites					
XV	1	1	a1	CAN	CML	SEB				
	1	1	c	AGU	CHI	BER	TRS	ORC		
	1	1	d1	MON	SAN	TRA	CEN	BER		
	1	1	e1	CSJ	TRA	TRS				
	1	7	a1.1	MON	MOR					
	1	8	a	AGU	MON	TRA	CEN			
	1	8	c	AGU	MON	MOR	SEV	SMR	UBE	ALA
	1	9	d	SET						
	4	2	a4.4	BAJ	CTO	MON	TRS	ORC		
XIV	1	1	b	AGU	CHI	GAN	TRA	BER	TRS	
	1	1	c	AGU	CHI	BER	TRS	ORC		
	1	1	d1	MON	SAN	TRA	CEN	BER		
	1	1	e1	CSJ	TRA	TRS				
	1	7	a3.2	SET						
	1	8	e3	BAJ	FUE	MON	SEV			
	1	9	e	SET						
	2	4	b	SET						
	Tomb	4	2	a1	MON	PEN	SAN	TRS		
	4	2	c2.2	CHI	MOR	BER				
	4	2	c2.7	SET						
	4	2	c3	MOR	ZON					
	4	3	a3.2	FUE	MOR	VAL				
4	3	a3.3	SET							
5	1	b	SEV							

Table 3. Groups of sites sharing the same ceramic subtype by each stratum (S) and level of Setefilla (SET). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

Setefilla (SET)

Despite the radiocarbon dates being obtained more than 40 years ago, they still allow us to place the material record found in strata XV and XIV in the Full Bronze Age layers. The sequence of Setefilla seems to begin in the Full Bronze Age; however, it is important to note that an open-area excavation and new radiocarbon analysis, in organic materials from this site, has to be performed in order to properly define an accurate chronology. The ceramic subtypes identified, and the sites sharing them with Setefilla, are shown in table 3.

The space of interaction for Setefilla stratum XV (fig. 19) shows a more intense blue gradient towards the countryside and the Sierra Morena regions, as well as the whole coast of the Lacus Ligustinus. The sites with the most shared ceramic subtypes are Monturque (seven subtypes), Cerro del Berrueco (five subtypes), Llanete de los Moros (five subtypes) and El Trastejón (five subtypes). Interaction gradients turn to red towards the southeast, which means that the energy and time needed to reach these areas is higher. However, some ceramic subtypes are still shared with the southeastern sites.

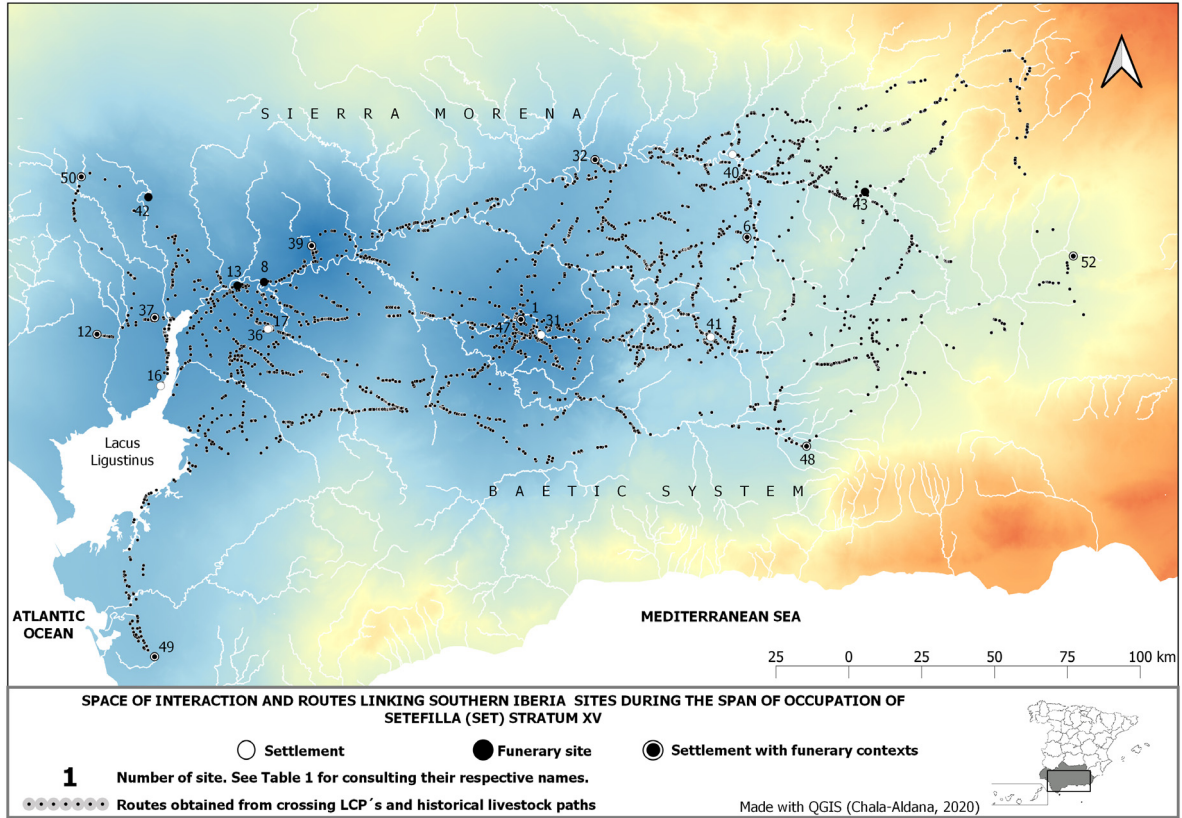


Fig. 19. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Setefilla (SET) (39) stratum XV.

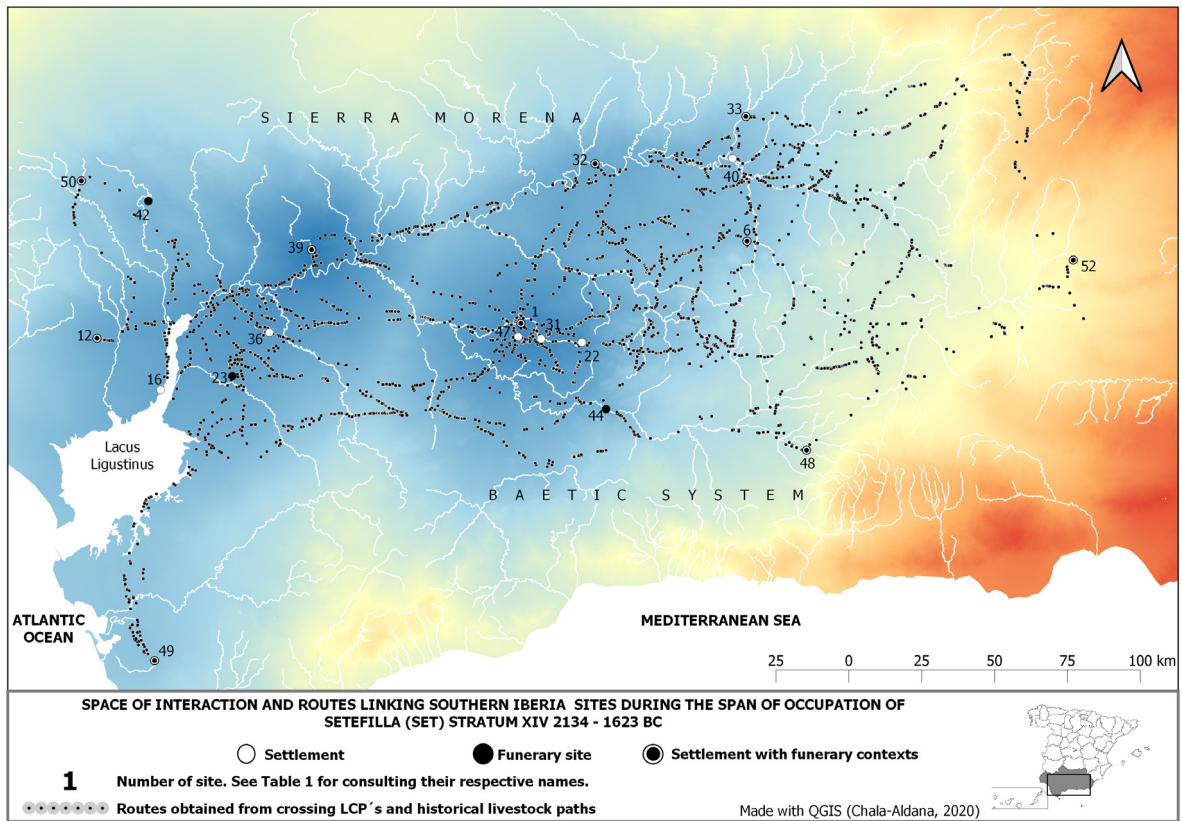


Fig. 20. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Setefilla (SET) (39) stratum XIV.

Mobility from Setefilla was possible through the Guadalquivir Route (*fig. 13*: Route 1) as well as several alternative branches of the Campiña–Los Alcores Route that lead directly to this site. The proximity of Setefilla to the Guadalquivir River and its excellent visibility from several points of the valley makes this site optimal for connecting with any region along the valley.

Only one exclusive subtype, or at least a subtype not coinciding with any other site included in this study, was found at Setefilla stratum XV. It is a low-carinated bowl with a linear zig-zag decoration in its internal body, just below the rim (Form 1, Type 9, Group d).

For Setefilla stratum XIV, the space of interaction maintains the same condition (*fig. 20*) but adds the High Guadalquivir to the regions with blue gradients, which means an increase in the number of sites in this region sharing ceramic subtypes. One example is the fragment of a reel-base cup (Form 5, Type 1, Group b) found also in High Guadalquivir sites such as Sevilleja (SEV). Such coinciding types are in accordance with the ideas regarding a social and cultural exchange with Argaric groups for this period, expressed not only in ceramics but also in metal grave goods (Aubert Semmler et al. 1983).

The amount of exclusive subtypes in Setefilla XIV is bigger than those observed in stratum XV. The ones identified are:

- Setefilla stratum XIV:
 - High-carinated bowl with divergent rim and zig-zag decoration in the inner body below the rim (Form 1, Type 7, Group a3.2).
 - (*) Low-carinated bowl with a slightly curved-divergent body (Form 1, Type 9, Group e).
 - Globular *orza* with *mamelón* on the shoulder and digital impressions along the rim (Form 2, Type 4, Group b).
 - Globular vessel with almond-like lip (Form 4, Type 2, Group c2.7).
 - Globular vessel with ellipsoidal body (Form 4, Type 3, Group a3.3).

As with Monturque, the exclusive forms could be indicative of autochthonous production of some ceramic subtypes. However, the low-carinated bowl subtype – marked with asterisk (*) – is also present in the southwestern and western peninsula (Senna Martínez et al. 1984), meaning that

not only Monturque, but also Setefilla, could have interacted beyond the Guadalquivir basin, something that can be verified according to the space of interaction that links Setefilla with the Sierra Morena region, a traditional route of access to the southwestern peninsula.

El Trastejón (TRS)

The radiocarbon chronology in El Trastejón confirms its occupation between the 3rd and 2nd mill. BC. However, there is no evidence of Chalcolithic or Bell Beaker sequences before this. As with Setefilla, the first occupation layer belongs to an early phase of the Bronze Age, which continues without any interruption until the Final Bronze Age (Hurtado Pérez et al. 2011). Table 4 shows the ceramic subtypes identified, and the sites sharing them with El Trastejón.

The space of interaction for El Trastejón shows an intense blue gradient towards the Lacus Ligustinus and the countryside regions (*fig. 21*). This condition is expressed when looking at the sites with the most shared ceramic subtypes: Cerro del Berrueco (six subtypes), Castillo de Aguilar, Monturque and Setefilla (all with five subtypes). Unlike the sites in the Middle Guadalquivir, the red gradient towards the southeast is indeed indicative of a lack of coinciding subtypes between El Trastejón and the so-called Argaric sites. The gradient towards the Sierra Morena, via Guadiana valley, is indicative of the contacts, already confirmed, between the sierra and the southwestern peninsula (Hurtado Pérez et al. 2011).

The main corridors connecting the site of El Trastejón with the Guadalquivir valley are the Rivera del Cala–Los Alcores and the Rivera del Cala–Aljarafe Routes (*fig. 13*: Route 3 and 4). From Los Alcores, the paths continue until reaching the Atlantic coast and the countryside regions. El Trastejón was a very important place, linked to the corridor connecting the Guadalquivir and the Guadiana valleys, something confirmed with the presence of several Southwestern Bronze ceramics that coincide with most of the typology from El Trastejón, and some subtypes from Monturque or Setefilla. Its condition as a ‘halfway site’ is also expressed in the lack of exclusive ceramic subtypes.

Level	Form	Type	Sub	Coinciding Sites											
	1	1	b	AGU	CHI	GAN	SET	TRA	BER						
	1	1	c	AGU	CHI	SET	BER	ORC							
	1	1	e1	CSJ	SET	TRA									
C2	1	2	a3	BAJ	MON	SEV	BER								
C4	1	3	a1.3	CHI	FUE	MON	ZON	NEG							
F22	1	5	a	AGU	ARC	BAJ	CHI	COJ	ENC	FUE	MON	MOR	PEN	SAN	
K10							SEK	TRA	ZON	BER	ALA	NEG	ORC		
	1	7	b	AGU	CSJ	SEK	BER								
	1	8	b2	AGU	ESP	MES	BER								
	4	2	a1	MON	PEN	SAN	SET								
	4	2	a4.4	BAJ	CTO	MON	SET	ORC							

Table 4. Groups of sites sharing the same ceramic subtype with the set of trenches excavated at El Trastejón (TRS). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

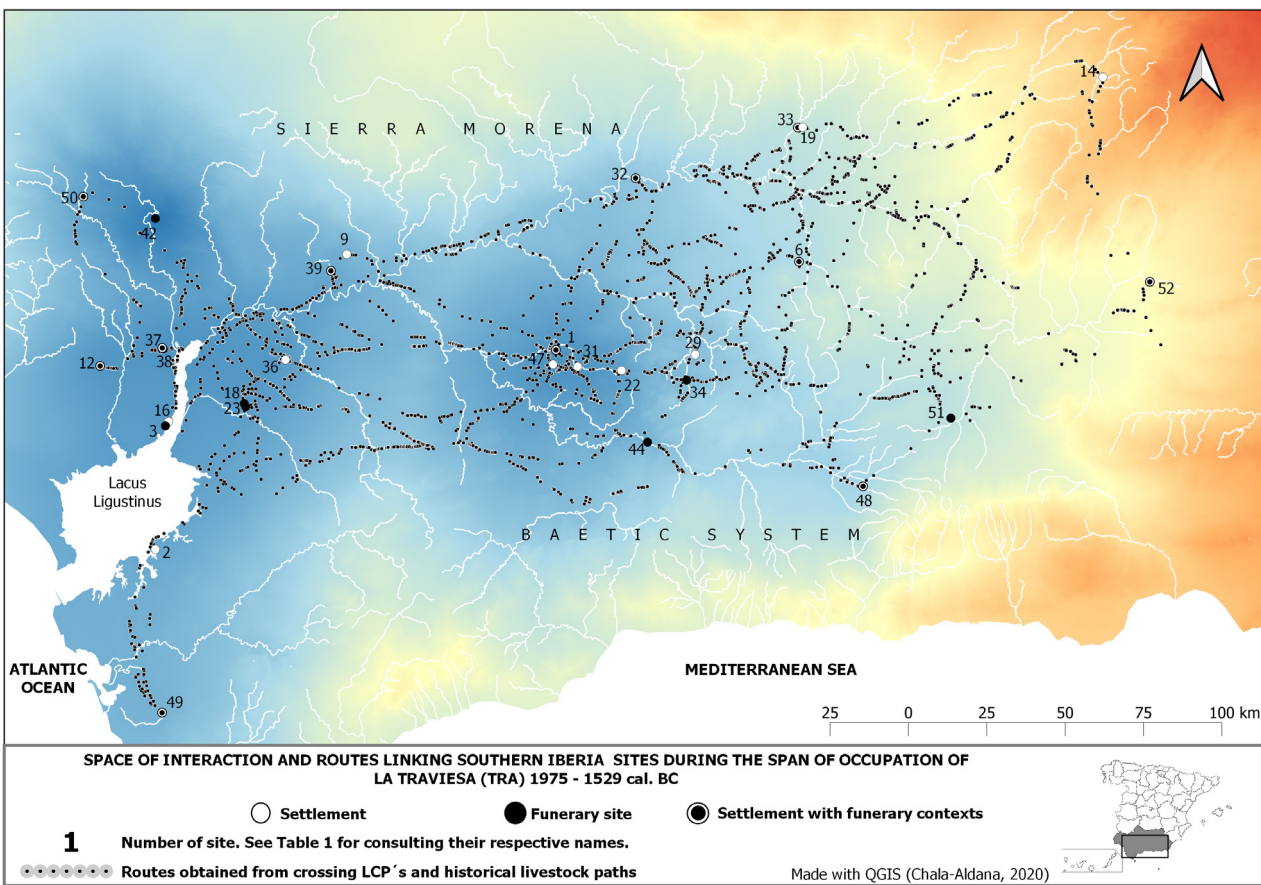


Fig. 21. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of El Trastejón (TRS) (50).

Level	Form	Type	Sub	Coinciding Sites																
Cist 20	1	1	d1	MON	SAN	SET	CEN	BER												
	1	1	b	AGU	CHI	GAN	SET	BER	TRS											
	1	1	e1	CSJ	SET	TRS														
	1	3	a1.1	MON	VAL	ZON	CEN	ALA												
	1	3	a1.5	TRA																
	1	4	a4.2	CAR	MON	PEN	PIR	SAN	SEB	BER										
	1	4	c	CHI	SAN															
	1	5	a	AGU	ARC	BAJ	CHI	COJ	ENC	FUE	MON	MOR	PEN	SAN						
								SEK	ZON	BER	TRS	ALA	NEG	ORC						
	1	8	a	AGU	MON	SET	CEN													
	1	8	b1	MES	MON	CEN														
	1	10	a1.4	MON																
	1	10	b	CHI	MON	MOR	ZON	NEG												
	1	10	d1	ALC	CVQ															
	4	1	a2	SEK																
	4	1	b1	TRA																
	4	3	a2.2	MON																

Table 5. Groups of sites sharing the same ceramic subtype with the site of La Traviesa (TRA). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

La Traviesa (TRA)

The radiocarbon chronology in La Traviesa places its occupation during the second half of the 2nd mill. BC. The necropolis site was occupied after El Trastejón; however, the site also seems to have the same continuity pattern along the Bronze Age (García Sanjuán 1998). The ceramic subtypes identified, and the sites sharing them with La Traviesa, are shown in table 5.

As with El Trastejón, the interaction space of La Traviesa shows an intense blue gradient towards the Lacus Ligustinus and the countryside regions (fig. 22). However, there is also a light blue gradient towards the Sierra Nevada, next to the Guadix valley, indicative of the presence of southeastern ceramic subtypes, and interactions between these two regions. The sites with the most shared ceramic subtypes are Monturque (nine subtypes), Chichina, Plaza de Santiago, Setefilla, Cerro de la Encina and Cerro del Berrueco (with four subtypes each).

The fact that it is in the same corridor as El Trastejón is also indicative of the relevance of this site in the communications between the Guadalquivir and the Guadiana valleys. The fact that some southeastern ceramic types are also present in La Traviesa is also indicative of the use of the Guadalquivir Corridor, or the prolongation of the route towards Los Alcores, to the countryside and from there to the Guadix valley (fig. 13).

One exclusive subtype was found for La Traviesa, one third of a spherical bowl with an external bevel (Form 1, Type 3, Group a1.5). However, the presence of just one subtype is not indicative of autochthonous production. As mentioned above, most of the subtypes in La Traviesa share typological traits with southwestern sites, indicative of the large amount of interaction between the Sierra Morena region, the Guadiana valleys and the rest of the western peninsula. If southwestern sites were included in this study, the space of interaction in blue would likely extend towards the southwest.

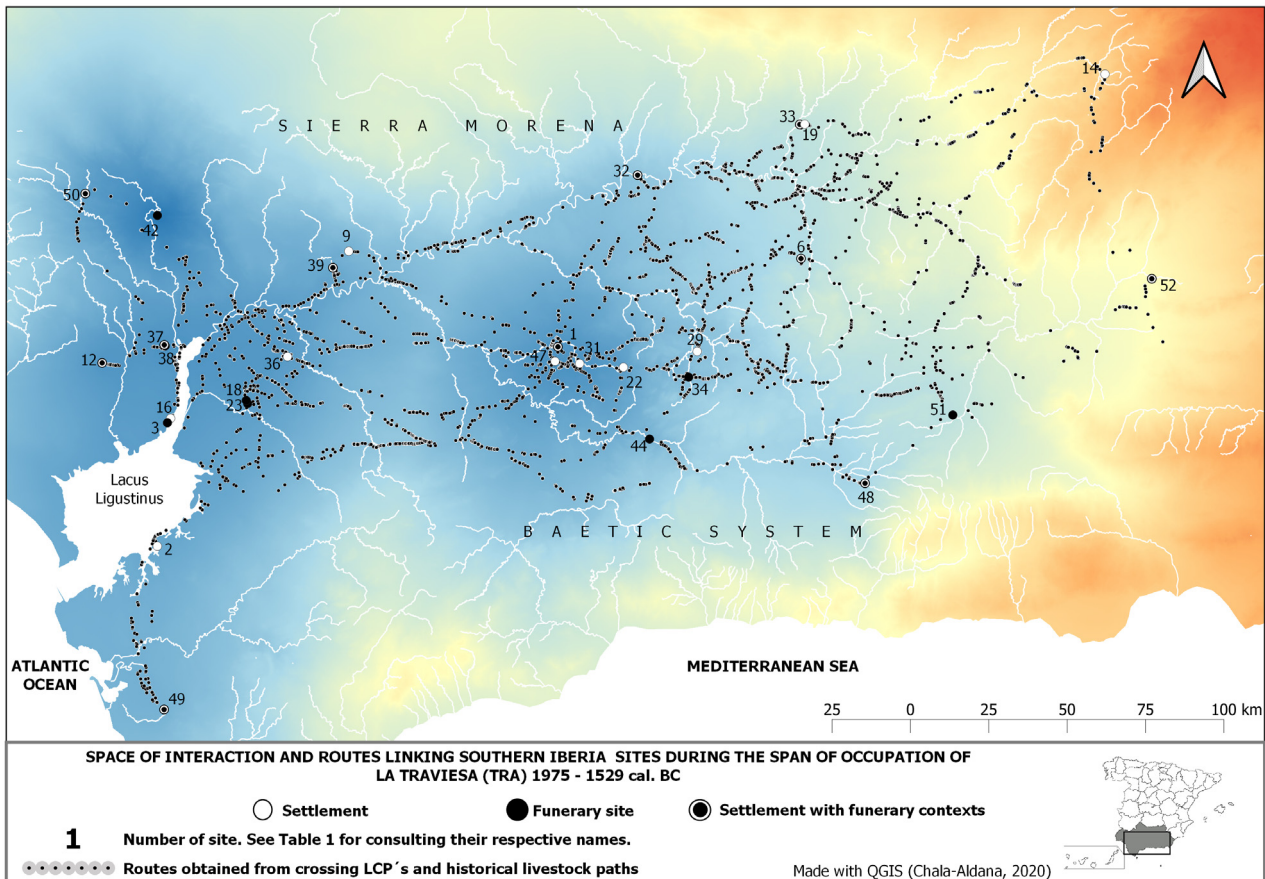


Fig. 22. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of La Traviésa (TRA) (42).

Cobre las Cruces (SEK–SEB)

The radiocarbon chronology places the site of Cobre las Cruces in the transition between the 3rd and 2nd mill. BC. The site is older than La Traviésa but younger than El Trastejón; however, its sequence continues without interruption during the Final Bronze Age and even subsequent ages (Hunt Ortíz 2012). The three sites also share the characteristic lack of Bell Beaker ceramics or previous occupation layers. The ceramic subtypes identified, shared with the site of Cobre las Cruces are summarised in table 6.

The space of interaction departing from Cobre las Cruces shares the same condition as the one observed for El Trastejón (TRS). The intense blue gradient is towards the Sierra Morena, the Lacus Ligustinus and the countryside regions (fig. 23). Despite sharing one subtype with sites such as Cuesta del Negro (NEG) and Orce (ORC), the

amount of energy and time needed to reach these regions is higher. The sites with most shared ceramic types are Cerro del Berrueco and La Traviésa (with three subtypes). The blue gradient in the countryside is expressed in the amount of sites from this region with one or two shared subtypes.

The main corridors connecting the site of Cobre las Cruces are the Guadalquivir and the Aljarafe–Riviera del Cala Routes (fig. 13: Route 1 and 4). The connection with the Atlantic Coast regions was also guaranteed, likely through the navigation of the Lacus Ligustinus or the use of the terrestrial paths surrounding the coast.

No exclusive subtypes were found for the site of Cobre las Cruces, which is indicative of the corridors converging at the Guadalquivir Mouth. Along with Los Alcores, El Aljarafe is a converging region, receiving all the people moving inside and outside the Middle and Low Guadalquivir valley.

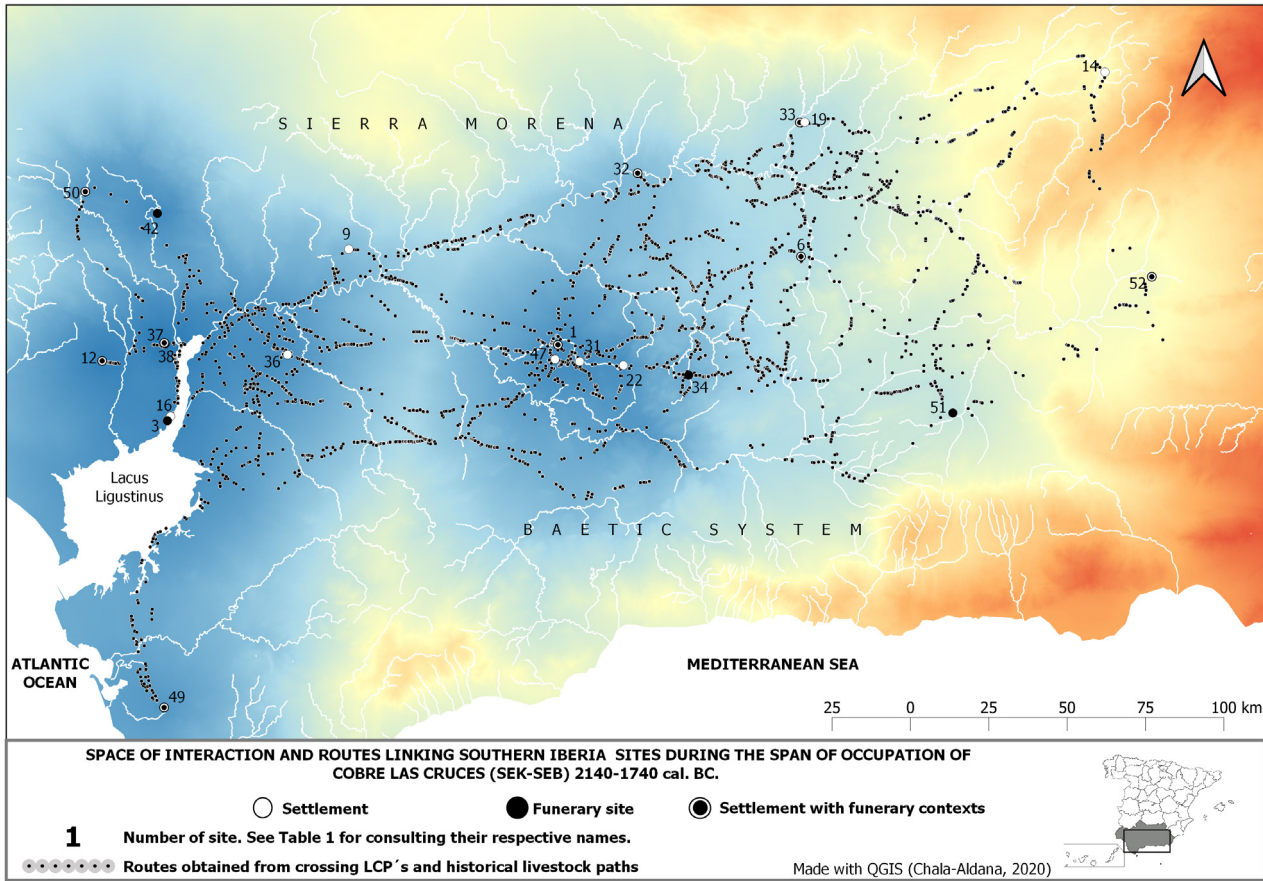


Fig. 23. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Cobre las Cruces (SEK-SEB) (37-38).

S	Level	Form	Type	Sub	Coinciding Sites												
T-4B	SEB	1	4	4.2	CAR	MON	PEN	PIR	SAN	TRA							
T-7 (1)	SEK	4	1	a2	TRA												
T-23b (3)	SEK	1	5	a	AGU	ARC	BAJ	CHI	COJ	ENC	FUE	MON	MOR	PEN	SAN		
-	-	1	7	b	AGU	CSJ	BER	TRS	TRA	ZON	BER	TRS	ALA	ORC	NEG		

Table 6. Groups of sites sharing the same ceramic subtype by each stratum (S) and level of Cobre las Cruces (SEB-SEK). Types and subtypes can be observed in fig. 28-38. For the abbreviations of the coinciding sites, see table 1.

Cerro del Berrueco (BER)

Despite radiocarbon dates being obtained several decades ago, the stratigraphic sequence allows us to place the site in the transition between the Copper and Bronze Ages. Stratum I contains several Chalcolithic and Bell Beaker pieces and continues with the II and III Bronze Age strata. The site maintains its sequence without interruption, showing

an apparent continuity in its occupation until the Final Bronze Age. Table 7 shows the ceramic subtypes identified along the study area shared with the Cerro del Berrueco site.

For Cerro del Berrueco II, the space of interaction shows an intense blue gradient towards the Lacus Ligustinus, the countryside and the High Guadalquivir regions (fig. 24). The expression of such a gradient can be seen in the sites

S	Form	Type	Sub	Coinciding Sites										
II	1	1	b	AGU	CHI	GAN	SET	TRA	TRS					
	1	1	c	AGU	CHI	SET	TRS	ORC						
	1	1	d1	MON	SAN	SET	TRA	CEN						
	1	1	e2	ARC	ARR	BAJ	MON	RIB	ZON	ORC				
	1	2	a1.1	BAJ	MON	ZON	CEN	ALA						
	1	2	a3	BAJ	MON	SEV	TRS							
	1	2	c	BAJ	PIR									
	1	4	a1	AGU	MON	PEN	ORC							
	1	4	a4.2	CAR	MON	PEN	PIR	SAN	SEB	TRA				
	1	5	a	AGU	ARC	BAJ	CHI	COJ	ENC	FUE	MON	MOR	PEN	SAN
								SEK	TRA	ZON	TRS	ALA	NEG	ORC
	1	6	b	AGU	ARR	BAJ	MON	ZON	ALA					
	1	6	c	BAJ	MOR	ALA								
	1	9	a2	AGU	ERA	ALA								
	1	10	a1.1	BAJ	JUA	MON	MOR	PEN	PIR	SMR	TRS	ALA		
	1	11	a1.1	BAE	PEN	SEV	ZON							
	1	11	b1	BAE	PEN									
	4	2	a4.3	CGF	MON	MOR								
	4	2	c2.2	CHI	MOR	SET								
III	1	7	a1.2.1	AGU	COR	MES	VIL	NEG						
	1	7	b	AGU	CSJ	SEK	TRS							
	1	8	b2	AGU	ESP	MES	TRS							

Table 7. Groups of sites sharing the same ceramic subtype by each stratum (S) of Cerro del Berrueco (BER). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

with the most ceramic subtypes shared, Monturque (eleven subtypes), Marroquies Bajos (eight subtypes), Castillo de Aguilar (seven subtypes), El Trastejón, Peñalosa and Llanete de los Moros (six subtypes).

There are two main access routes to Cerro del Berrueco identified: the Atlantic Coast–Los Alcores, and the Atlantic Coast–Campiña Routes. The path starts going parallel to the coast of the Lacus Ligustinus and then it breaks in two. One path head to Los Alcores and from there to the High Guadalquivir, whereas the other goes to the countryside and from there to the Guadix valley (fig. 13). The communication with the Sierra Morena and El Aljarafe regions was likely linked to the navigation of the Lacus Ligustinus as well as to the use of the paths surrounding it.

For Cerro del Berrueco III, there is a change in the space of interaction (fig. 25). There is an intensification of the blue gradient in the countryside region, whereas the High Guadalquivir sees a reduction in the grade of interaction visible in the former period. Such interactions are expressed in the ceramic types shared mainly with Castillo de Aguilar (three subtypes), La Mesa (Fuente Tójar) (two subtypes) in the Middle Guadalquivir, and El Trastejón (two subtypes) in the Sierra Morena.

There are no exclusive types coming from Cerro del Berrueco. The site has been considered, since Chalcolithic times, as a place with many interactions with other regions along the Atlantic Coast as well as the Guadalquivir valley, even an ‘Argaric expansion’ has been considered based on the ceramic material found in stratum III

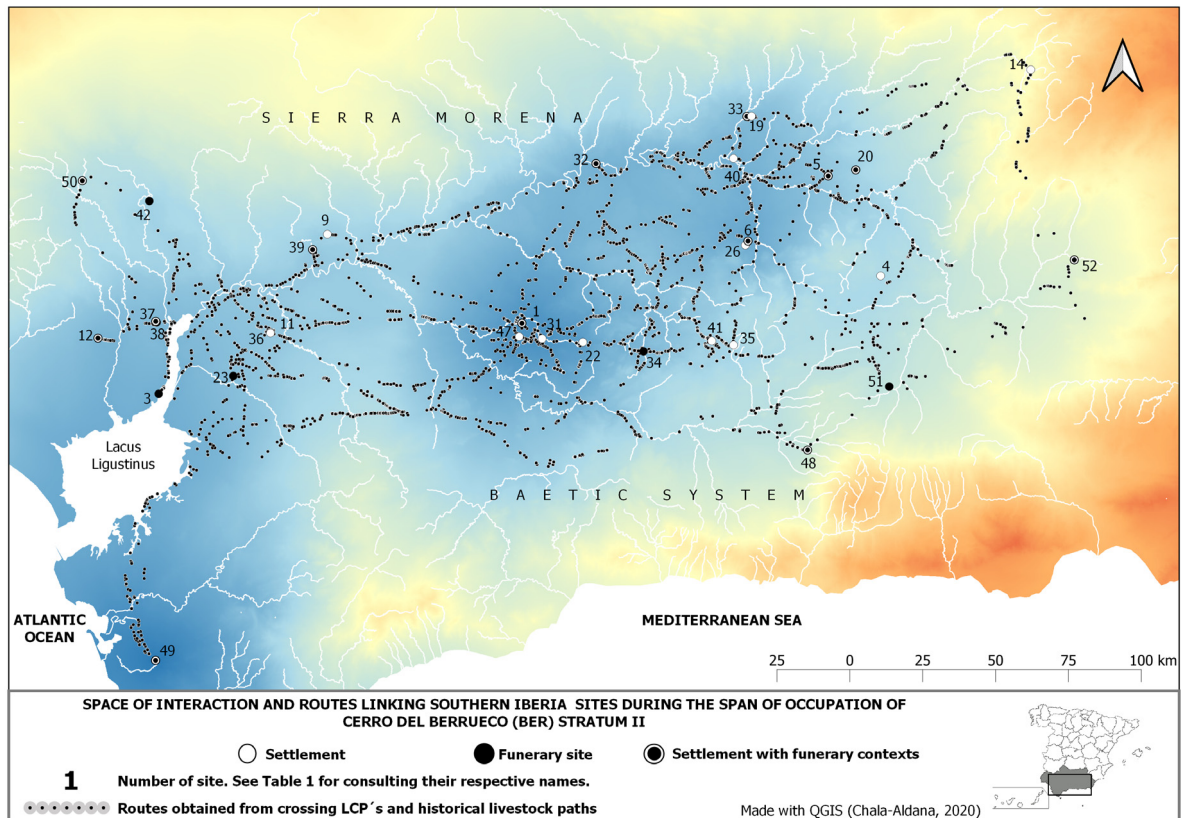


Fig. 24. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Cerro del Berrueco (BER) (49) stratum II.

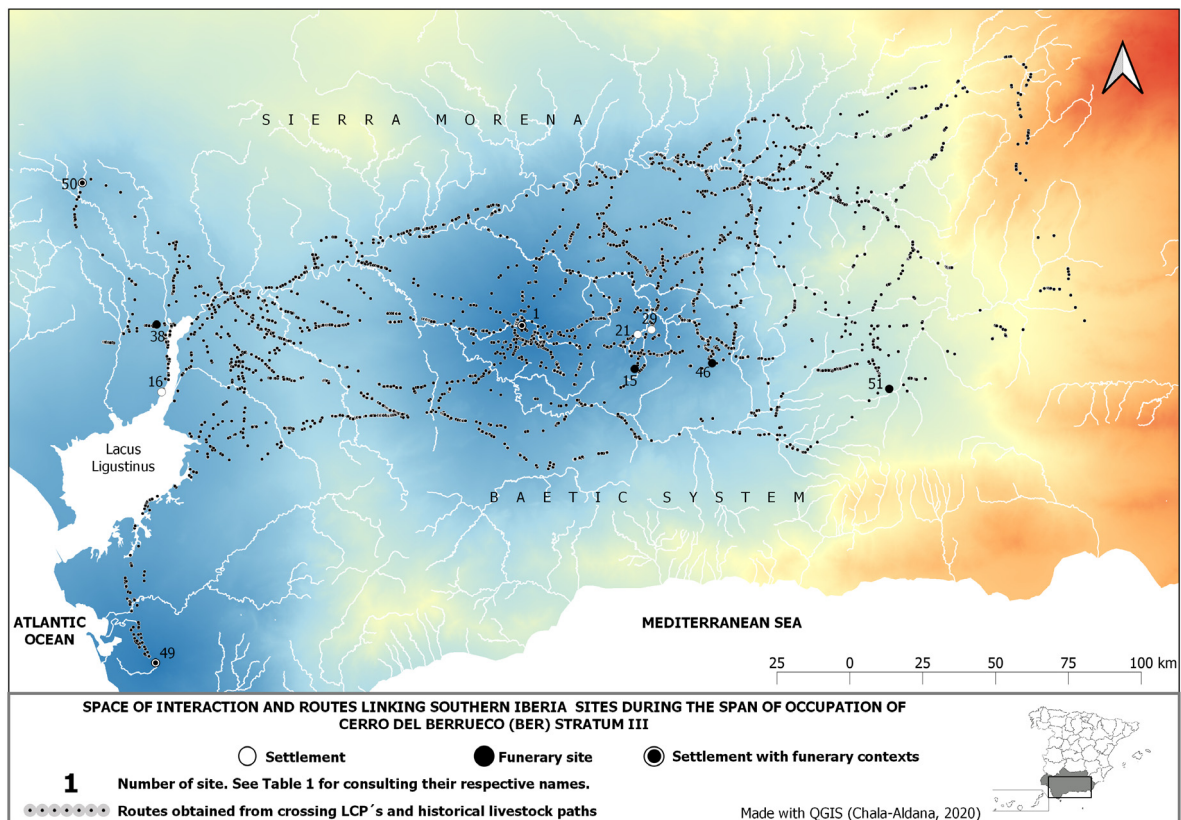


Fig. 25. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Cerro del Berrueco (BER) (49) stratum III.

S	Form	Type	Sub	Coinciding Sites											
II	1	7	b	AGU	SEK	BER	TRS								
	1	1	e1	SET	TRA	TRS									
	3	1	a	ARR	BAE	ERA	FUE	GUT	PEN	PIR	SEV	CEN	ALA	NEG	
	4	2	a4.2	CSJ											

Table 8. Groups of sites sharing the same ceramic subtype by each stratum (S) of Cerro de San Juan (CSJ). Types and subtypes can be observed in fig. 28–38. For the abbreviations of the coinciding sites, see table 1.

(Escacena Carrasco/Berriatúa Hernández 1985). Is it possible to consider ‘territorial’ expansions based on the presence of Argaric materials in Cerro del Berrueco?

The archaeotopogram shows that the energy and time spent to move between the Atlantic Coast and the southeast is higher. Additionally, for Cerro del Berrueco III, the model shows that the interactions with the High Guadalquivir and the southeast are decreased. Departing from the first level of interpretation, the presence of carinated bowls in the funerary contexts of Cerro del Berrueco is only proving a moment of interaction between the Atlantic and the southeast regions. Certainly, knowledge about funerary rituals and its associated objects flowed between them; however, the knowledge, or the objects, could have arrived from intermediate regions, such as the Middle Guadalquivir as well. Sites such as Castillo de Aguilar in the countryside have the most of interactions with Cerro del Berrueco and also share the same type of high-carinated bowls considered by Escacena Carrasco and Berriatúa Hernández (1985) to indicate an Argaric expansion. It is possible that the southeastern ceramic styles, or the knowledge to elaborate them, if arrived in Cerro del Berrueco, must have passed first through the countryside, meaning that this interaction was not made directly from an ‘expanding Argaric territory’, but from a region in between.

Additionally, such high-carinated bowls are also present in El Aljarafe and the Sierra Morena regions, which makes the argument of the Argaric expansion difficult to prove considering the enormous amount of interactions observed through the Middle and Low Guadalquivir valley and beyond. Indeed, these subtypes were shared, but such overlaps in subtypes must be read more as

evidence of knowledge and objects flowing than of a ‘territorial expansion’. To prove such an expansion, it would be necessary to find other complementary types of evidence.

Cerro de San Juan (CSJ)

The radiocarbon chronology of Cerro de San Juan places the site in the transition between the 3rd and 2nd mill. BC. As with Monturque and Cerro del Berrueco, Cerro de San Juan has layers with Bell Beaker materials; however, Escacena Carrasco and García Rivero (García Rivero/Escacena Carrasco 2015; Escacena Carrasco/García Rivero 2018) claim that there was no such population continuity between the Chalcolithic and the Bronze Age, arguing instead for a population replacement model. Archaeotopograms could contribute to such a discussion. The ceramic subtypes shared between Cerro de San Juan and other sites along the study area are shown in table 8.

The space of interaction of Cerro de San Juan shows an intense blue gradient towards the Sierra Morena, the region around the Lacus Ligustinus and the High Guadalquivir as well as a slight gradient towards the Guadix valley (fig. 26). However, in this case, the differences between regions according to the amount of subtypes shared do not exist and the number of shared types with each site is always 1. This distribution indicates that, at least for the span of time of occupation of Cerro de San Juan, knowledge or materials from all these corners flowed between all these regions.

As mentioned above, in the area between Los Alcores and El Aljarafe there is a confluence of corridors that meet at this point. The amount of coinciding subtypes, despite not being at the level

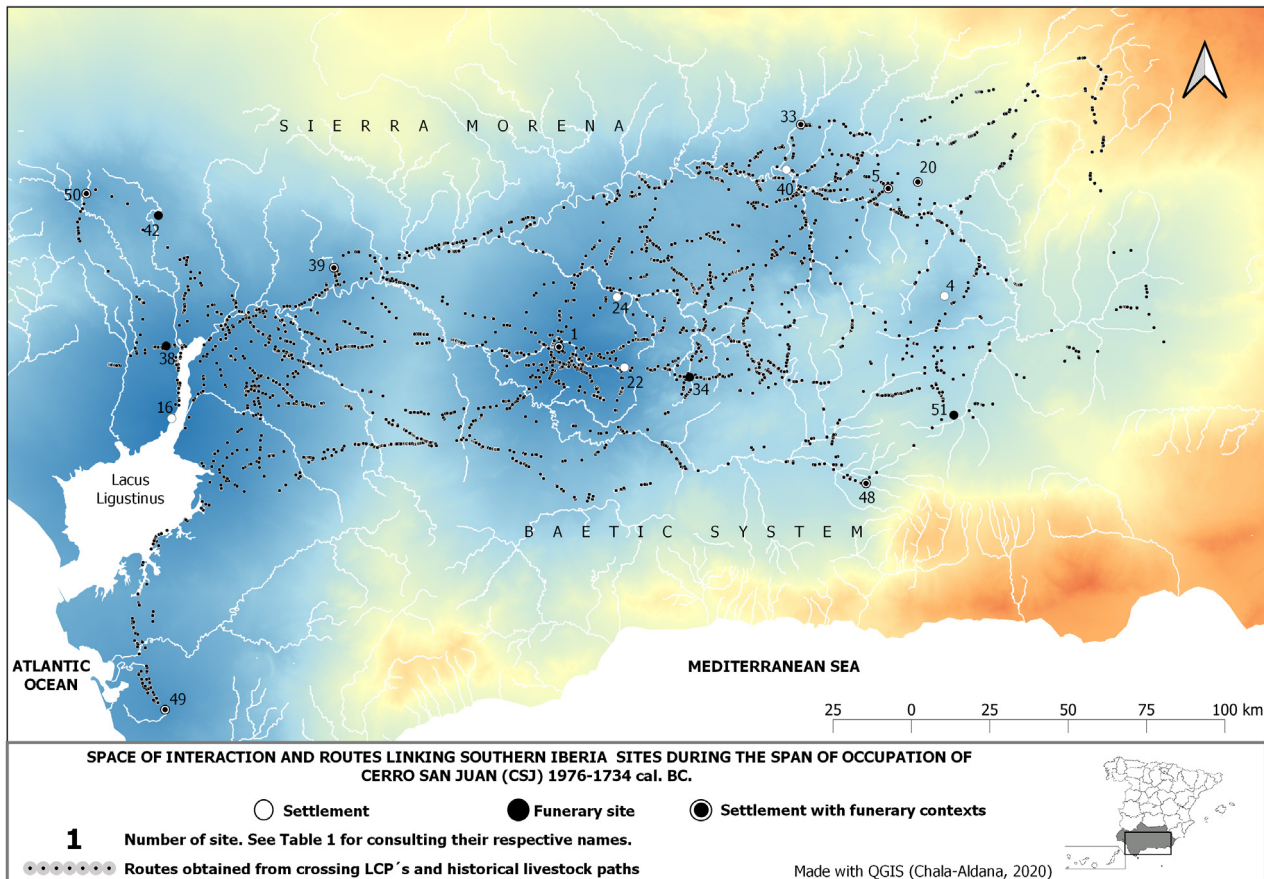


Fig. 26. Archaeotopogram showing the space of interaction and routes linking sites sharing ceramic subtypes with the site of Cerro de San Juan (CSJ) (16).

of other sites, indicates that the communication with all these regions indeed existed. The corridor along the Guadalquivir, the Campiña–Alcores, and the Aljarafe–Rivera del Cala Routes made such interactions possible (fig. 13: Route 1, 2 and 4).

One exclusive type was found for Cerro de San Juan: a globular vessel with spherical body and bevelled rim (Form 4, Type 2, Group a4.2); however, it is not representative of an autochthonous production as in the case of La Traviesa (TRA).

García Rivero and Escacena Carrasco (2015), consider that the cultural historical approach provoked archaeologists to consider the continuity of materials in stratigraphic sequences as evidence of the continuity of ‘cultures’ or traditions and the spatial distribution of a material culture as the geographical frame for their expansion, these sequences were called ‘horizons’. Indeed, the cultural historical approach has motivated archaeologists to seek ‘cultures’ and to think all the time in terms of ‘cultures’.

When analysing stratigraphic sequences or the distribution of ‘horizons’, archaeologists tend to consider particular traits and types as manifestations of a particular ‘cultural entity’ (as if such entity was a group ethnically and politically defined). However, whereas the material record is just the empirical evidence of a cultural expression (related with diverse spheres of life or death), the cultural entities are archaeological inventions. Researchers produce cartographic representations of delimited territories that are invented, along with representations of territorial expansions that are only evidenced by the presence or absence of a particular trait. Such an approach does not explain the way all the things that compose the so-called ‘culture’ (knowledge, ideas, beliefs, and materials) flow.

As García Rivero and Escacena Carrasco pertinently point, there was an ‘autochthonist’ trend among Andalusian archaeologists since the 1970s that refused diffusion as a possible trigger of

cultural changes. They also mention that cultural ‘continuity’ models would depend on evidence of a – if you will forgive the repetition – ‘continued’ use of settlements and architectural structures, something for which there also is not enough evidence (García Rivero/Escacena Carrasco 2015).

They propose a model of ‘puzzle replacement’, with Late Chalcolithic and Early Bronze populations coexisting, but with the older populations slowly vanishing due to ‘pressure’ from the younger ones. They find evidence for this hypothesis in the changes in funerary and settlement patterns, and in the changes in the kind of material culture used between the two periods along the region (García Rivero/ Escacena Carrasco 2015).

According to the scenario observed in the archaeotopograms elaborated for the sites with Bell Beaker substrates (MON, BER and CSJ), and considering that the Bell Beaker phenomenon also extended all over southern Iberia, it is indeed possible to say that a population replacement existed, considering the amount of *ex-novo* sites set in the same area; however, such replacement was not a radical one.

First, the archaeotopogram model shows how sites are still interconnected during the Bronze Age but not based on the same ceramic subtypes. There is a large diversity in the ceramic types behind the interactions represented for every site. Likewise, beyond the trend obtained from ceramics, the rest of the material culture also shows a large cultural diversity along the Middle and Low Guadalquivir valley. Moreover, the character of the sites compared is also diverse; they do not have the same sequences, or the same architectural style, funerary or settlement patterns. However, further research is needed in order to properly characterise such diversity. The evidence available is still not enough.

Such diversity inside such an interconnected area does not correspond to a continuity of the same population along the whole region. If this continuity did exist, then evidence would show the same material changes along every sequence of the Guadalquivir valley. It is necessary to avoid generalisations and consider models that allow us to think of parallel cultural processes going on, without leaning to only one. Population

replacement is a hypothesis to consider, however it is still unknown if it was related to massive movements of people. This is something that only started to be studied a few years ago.

Based on palynological analyses of sequences, paleoclimatic and paleodemographic calculations, relying on calibrated radiocarbon datasets, Lillios et al. (2016), Blanco-González et al. (2018) and Hinz et al. (2019) have worked on a hypothesis that suggests a demographic collapse in the southwest and an increase in population in the southeast between the 3rd and 2nd mill. BC. They argue that this collapse is likely related to the climatic changes that occurred during the 4.2 ky BP event. Lillios et al. (2016) consider a gradual migration of people from one corner to the other in southern Iberia.

Is it possible to think of a process of several generations, with people moving gradually from one side of southern Iberia to the other, through the corridors above mentioned, looking for better places for establishing new settlements, but at the same time meeting and sharing the same landscape with local Chalcolithic populations? Could this explain the diversity of cultural expressions observed especially in the Middle and Low Guadalquivir valley during the transitional Copper/ Bronze Age?

First, it is necessary to have more radiocarbon dates and palynological analyses from the Middle and Low Guadalquivir valley, something that does not exist yet. Despite fitting in a model of massive migrations between the southwest and southeast, the proposed hypothesis ignores the condition of the Middle and Low Guadalquivir valley, considering it as an essentially empty space, mainly because of the absence of data. Certainly, a model elaborated by comparing two corners without considering the centre will lead to such assumptions.

Archaeotopograms show that the Middle and Low Guadalquivir valley was not unoccupied during the Bronze Age and was not a low-ranked area. This means that if there was indeed a migration caused by climate, it was neither massive nor fast. It must have affected the whole of southern Iberia, provoking movements of people between regions (or inside them) and resulting in several interactions that ended in the diversity archaeologists find today. Indeed, some people were concentrated

in some regions, such as the southeast, while others remained in their traditional landscapes, and others moved back from the southeast and brought customs, ideas and objects that resulted in the Bronze Age layers of the Middle and Low Guadalquivir valley. All these interactions would have been integrated into the changing social and cultural environment of that moment.

Cerro de San Juan represents the first proposal that confronts the traditional ways of reading space during the Bronze Age in the Low Guadalquivir, but in order to complete the task, much more research and open area excavations, with radiocarbon dates, have to be conducted. If such research is not carried out, then all the discussions will be made from the second level of interpretation without enough evidence for affirmation.

The GIS model presented here could help to find more Bronze Age sites next to the corridors identified, and to bring new possibilities for exploring a period that has been understudied in the Middle and Low Guadalquivir regions.

6. Conclusion

Cultural historical approaches have influenced the way archaeologists read the past, regardless of the change in the techniques used, or the turns in the approaches used to interpret the material culture. There are two levels of interpretation, the first based on the empirical evidence, and the second on a higher theoretical and intellectual level; however, once established as a scientific tradition, these higher levels lead to researchers being focused on sustaining interpretations made decades ago.

This is how ceramic typologies, cartographical representations, or the perception of the space itself, end up subordinated to the idea of finding 'cultural entities'. These inventions do not help to get a grasp of the reality of the past, but instead buffer researchers from the humility required to go one step back and start to analyse the empirical evidence over again, from the first level of interpretation, reorganising it and trying to understand how it behaves. This is something that happens to all of us when we find ourselves too comfortable with our theories.

The history of the research of the Bronze Age in southern Iberia has been more focused on discussions at the second level, when at least, for the Middle and Low Guadalquivir valley, the empirical evidence is still not enough for such levels of discussion. It is necessary to go one step back and look again at the empirical evidence, or even better, look for it, because it is still missing.

The methodology presented here, identified a ceramic typology for the Middle and Low Guadalquivir valley which is not oriented towards claiming a new cultural area, but instead looks for indications of interactions in the valley and beyond. 47 sites were selected from the database of the Andalusian heritage institute (IAPH) and five more sites were added to establish comparisons with regions surrounding our study area. The shared ceramic subtypes identified were considered to be part of a network of interactions between sites that can be represented cartographically. Mapping interactions in the past, based on the material culture, can help overcome cultural historical models of arbitrary delimited territories and cultural entities that have not been confirmed or cannot be confirmed.

Such interactions were cartographically represented with the help of a Geographical Information System (GIS). The GIS calculated the least cost paths (LCPs) between all 52 sites included in the study. The main criteria for elaborating an LCP between two sites was having at least one shared ceramic subtype. All the networks of calculated LCPs were crossed with the network of historical livestock routes, some of which even have prehistorical origins. The spatial intersections (matches) identified between the LCPs and the livestock paths were the basis for identifying several corridors between the Bronze Age sites in this study.

These identified corridors connected all the corners of the Guadalquivir valley during the Bronze Age; however, the interactions were not precisely through them; this is just a model to depict the most likely paths where people and resources moved. People moved across the landscape in many directions, and GIS helped to calculate the cost distances for moving between sites with coinciding ceramic subtypes, based on raster

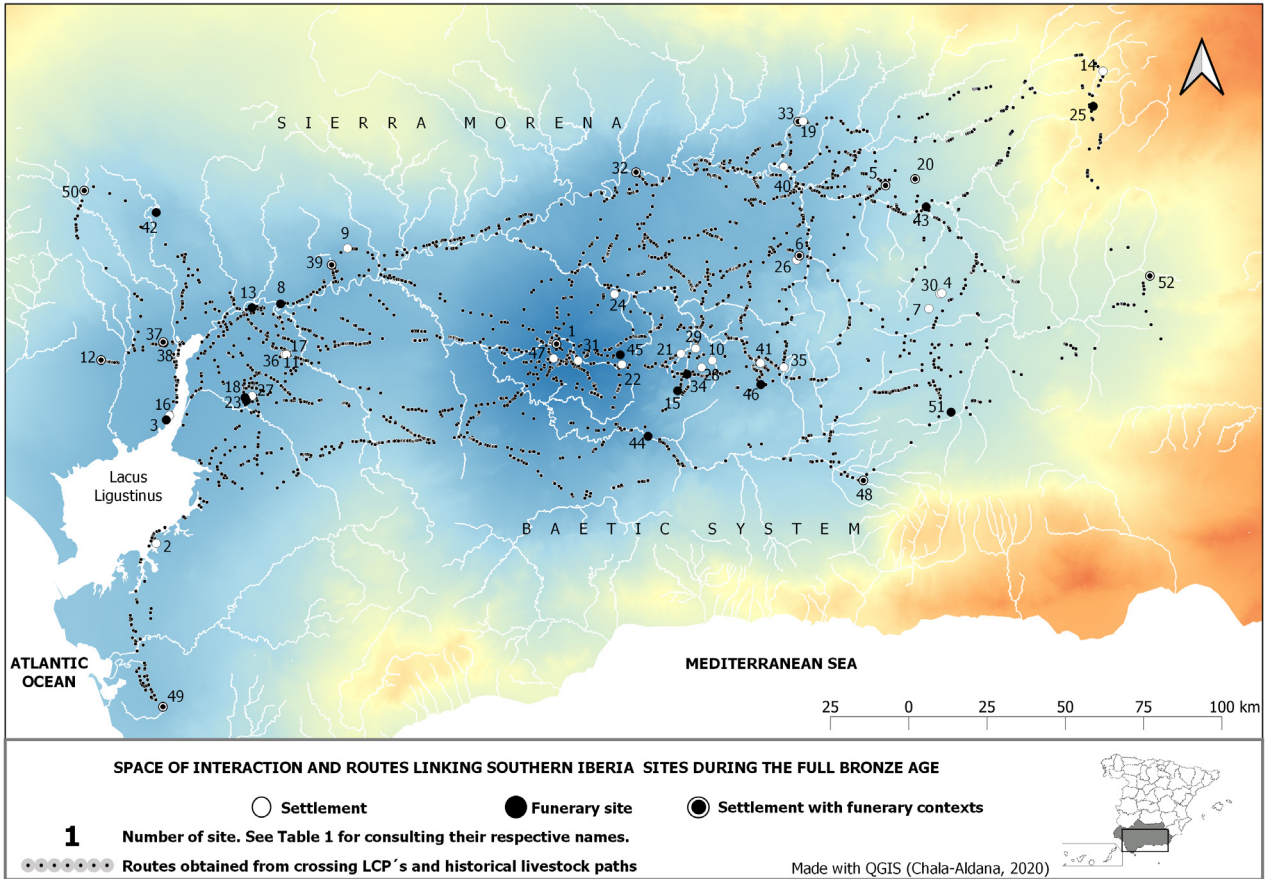


Fig. 27. Archaeotopogram showing the space of interaction and routes linking southern Iberia.

information on the elevation, slope and land cover along the study area.

From these calculations, a colour gradient that represented the energy and time spent for moving from one region to another was obtained. A cost distance map was calculated for every group of sites sharing every ceramic subtype. Then, the sites with confirmed occupation during the Bronze Age and with radiocarbon dates were selected and their cost distance maps were summed obtaining an archaeotopogram for each site.

Archaeotopograms include not only the costs for moving between sites, but also the spaces of interaction, which are calculated after summing all the cost distance maps obtained from all the coinciding ceramic subtypes, for a determined site and span of time. Spaces of interaction depart from the fact that two different sites sharing the same trait, during the same span of time, must have interacted at least once. Such interactions do not correspond to processes of acculturation

or territorial expansion, but to the simple fact of sharing knowledge about how to elaborate such objects or share the objects themselves.

The sum of all these interactions produces a gradient based on all the accumulated cost distances, or movements required to interact with another site. The more intense the blue, the more interactions identified because of the low energetic cost for moving; the redder, the less interaction and more energy needed.

Archaeotopograms were obtained for the sites of Monturque, Setefilla, El Trastejón, La Traviesa, Cerro del Berrueco, Cobre las Cruces and Cerro de San Juan, which are the sites with confirmed radiocarbon dates during the transition between the 3rd and 2nd mill. BC. The corridors identified were also added to the model.

Based on the archaeotopograms obtained for every site, it was possible to confirm that people in the Middle and Low Guadalquivir valley during the Bronze Age interacted between the sites and

also with other regions, such as the High Guadalquivir, the Sierra Morena and beyond (*fig. 27*). These interactions, and the cartographic representation obtained from the empirical evidence, show that this region was not low-ranked or unoccupied, especially since the history of research confirms that this region has been understudied and needs more survey and excavation campaigns to characterise it well.

The evidence of interactions obtained is also useful for discussing the way archaeologists perceive the space and think of the past. Indeed, drastic social and cultural changes occurred between the Chalcolithic and the Bronze Age. However, in the frame of such changes, ideas of delimited territories or cultural expansions tied with processes of territorial control are beyond what the empirical evidence can show us right now. Social and cultural changes indeed occurred, but within an interconnected environment, which is different from other models that consider a centralised space controlled by a small group of people.

Such high connectivity, among such diversity of cultural expressions found along the Middle and Low Guadalquivir, is indicative of other types of territorial organisation, far from the centralised territorial models. If the study was extended, and more sites from the southeastern and southwestern corners were added, it may be possible to show that the same level of connectivity has been present since Neolithic times. Possibly, the model would show that there were no territorial limits, but instead paths. Cultural borders are archaeological inventions founded in our current subsistence paradigm (Chala-Aldana 2020) which

resembles the idea of nations as cultural entities and the struggle for power between them.

People in the past perceived, thought about, and moved through their landscape in other ways, impossible to know for us. However, cartographic representations, elaborated from empirical evidence, are the tool proposed here to get useful information to create first level interpretations of the ways people interacted spatially in the past. This is a cumulative model, which means that its database can incorporate new types of information, not only regarding ceramics but also other kinds of material culture, and values obtained from several types of analysis performed in plants, animals or people. By including new types of information to the database, new explanations can be provided regarding social and cultural processes involving interaction between human groups in a region and their consideration of connectivity and the flow of knowledge as resources.

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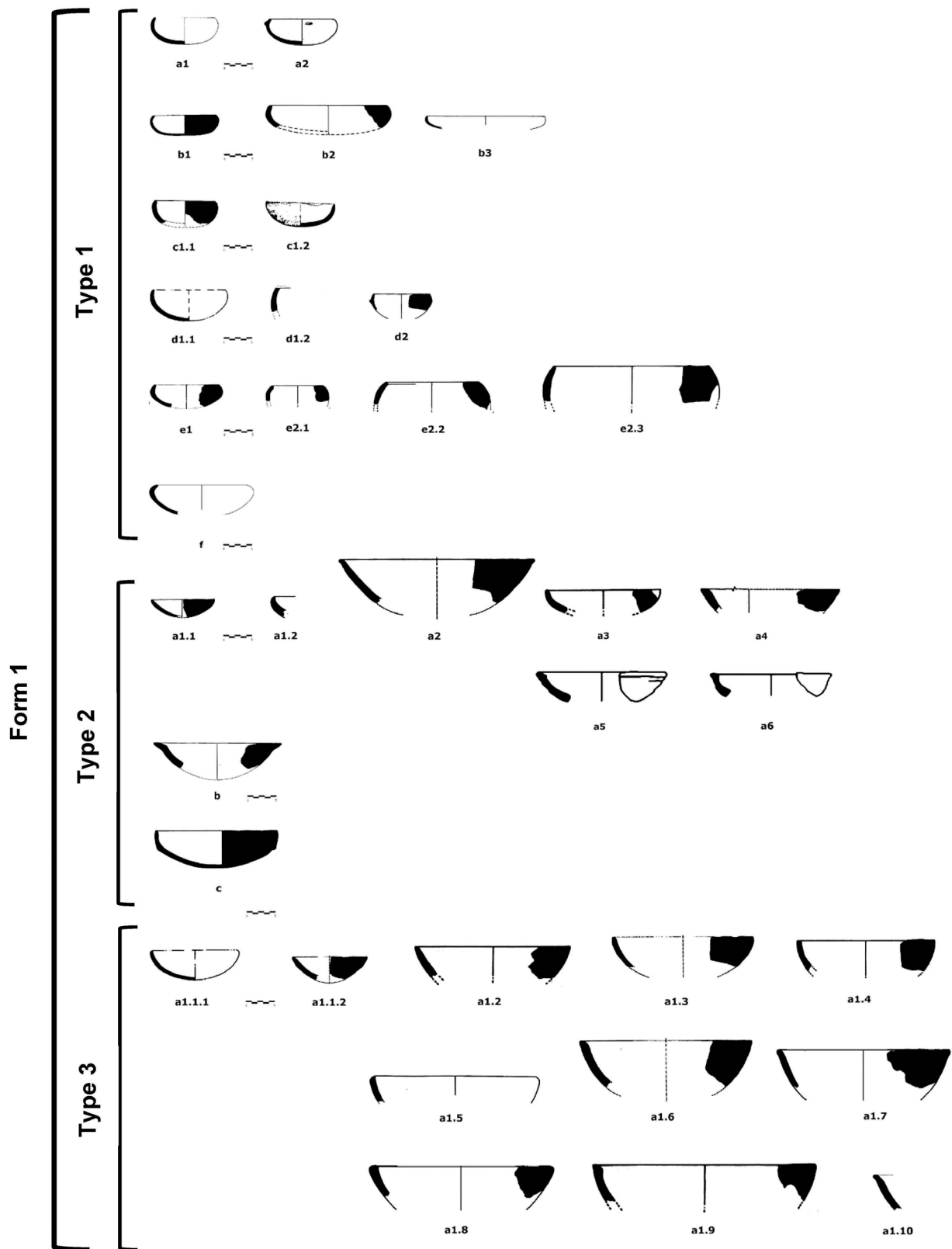


Fig. 28. Form 1. Types 1 to 3.

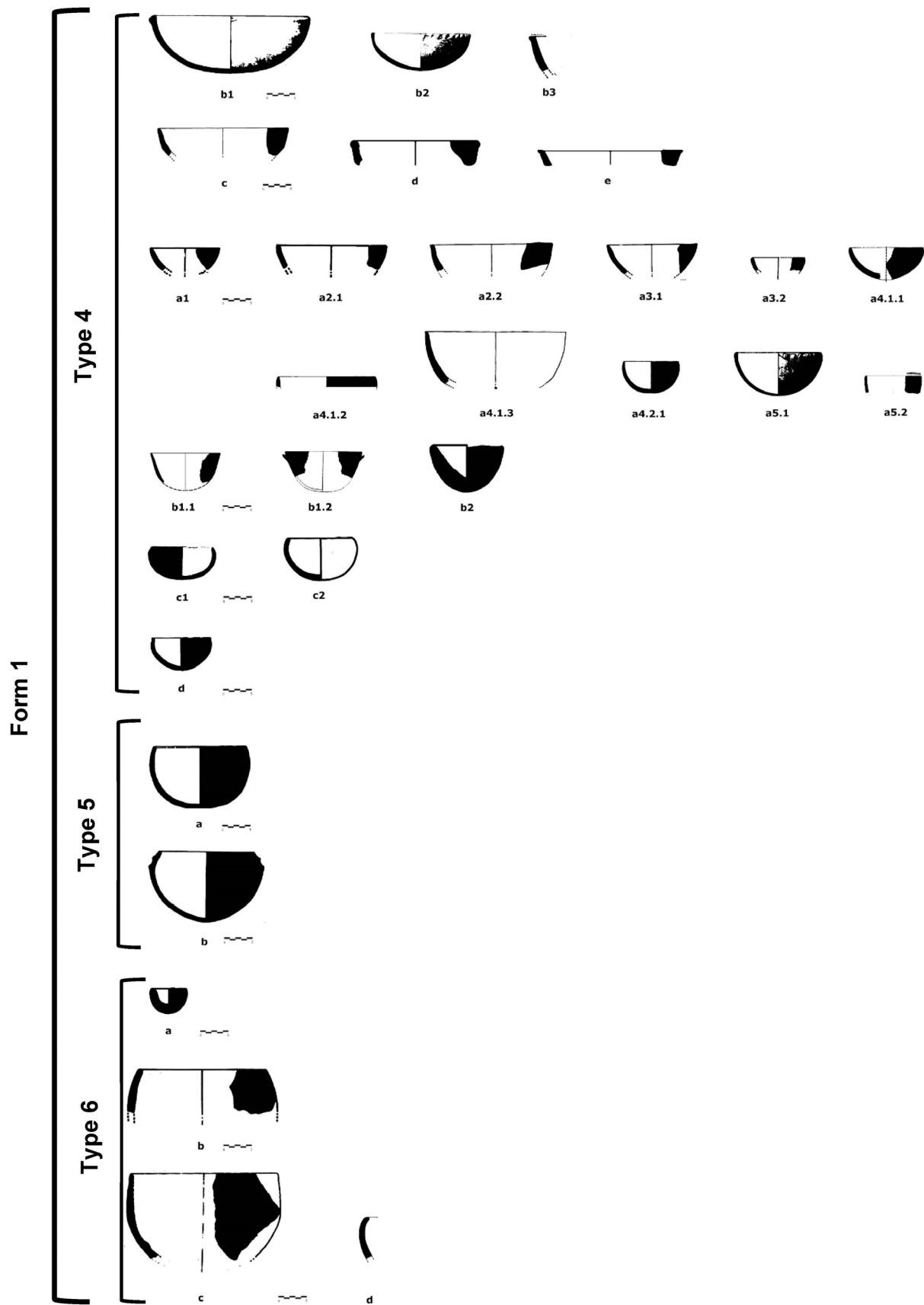


Fig. 29. Form 1. Types 4 to 6.

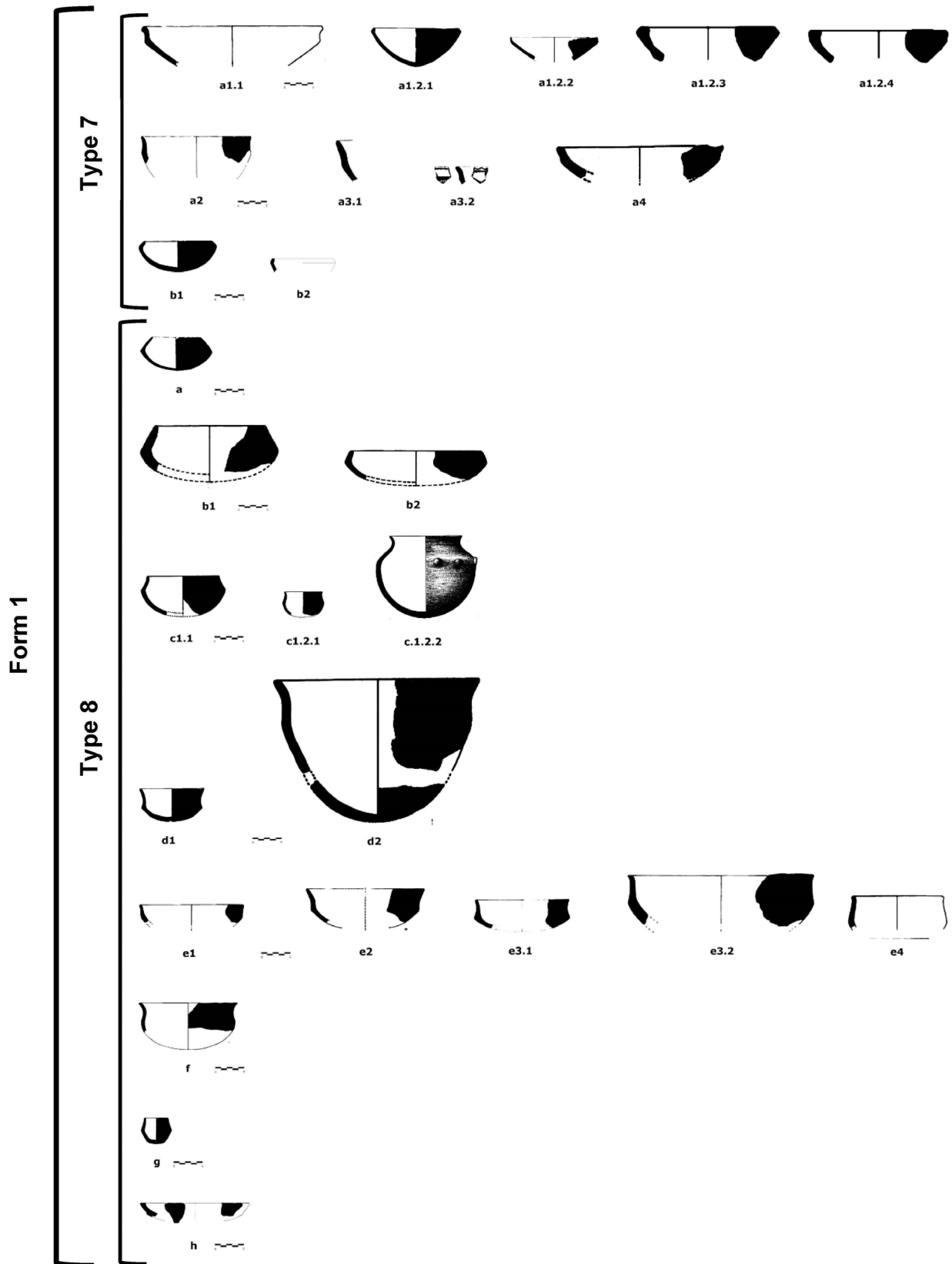


Fig. 30. Form 1. Types 7 and 8.

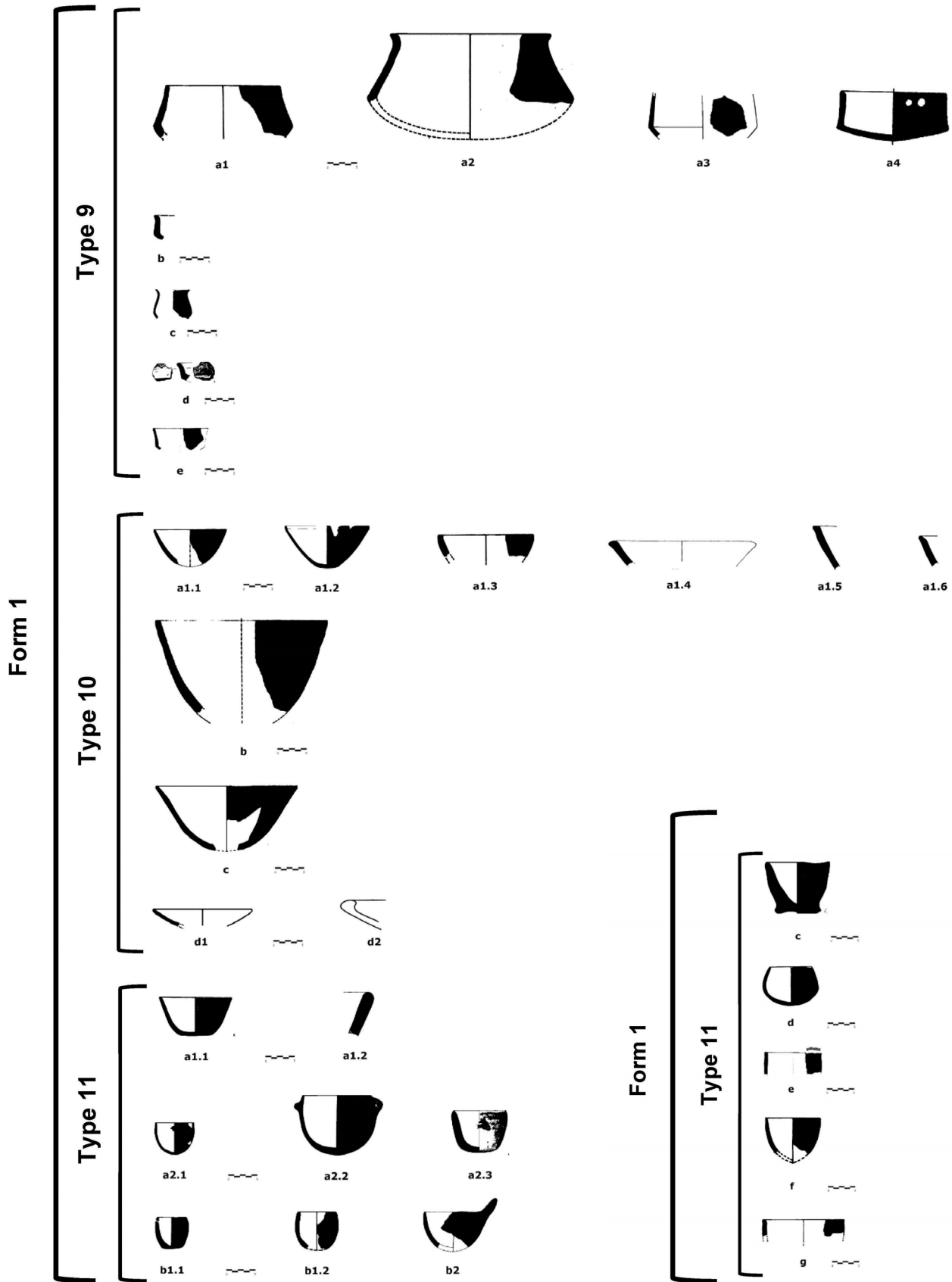


Fig. 31. Form 1. Types 9 to 11b.

Fig. 32. Form 1. Types 11c to 11g.

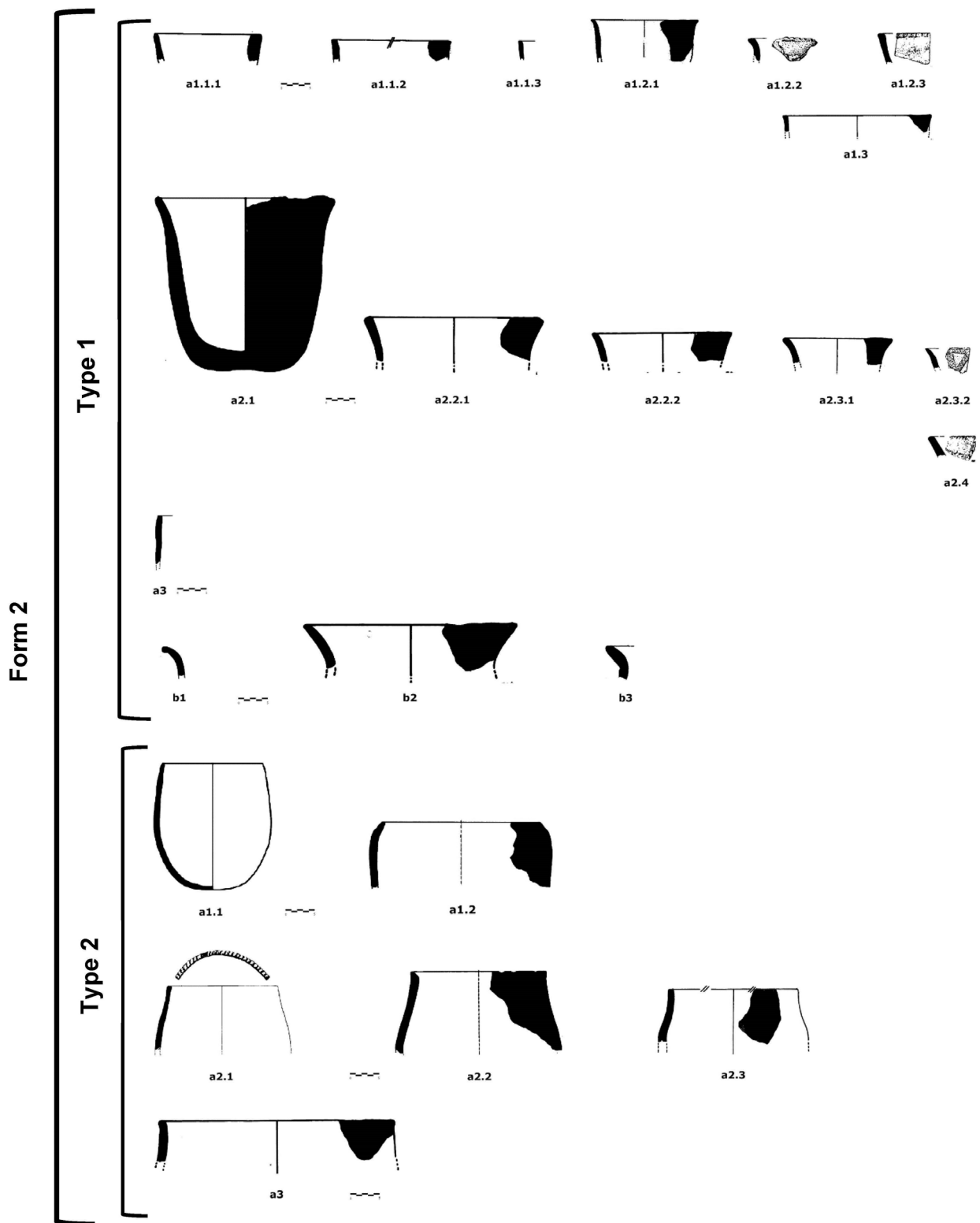


Fig. 33. Form 2. Types 1 and 2.

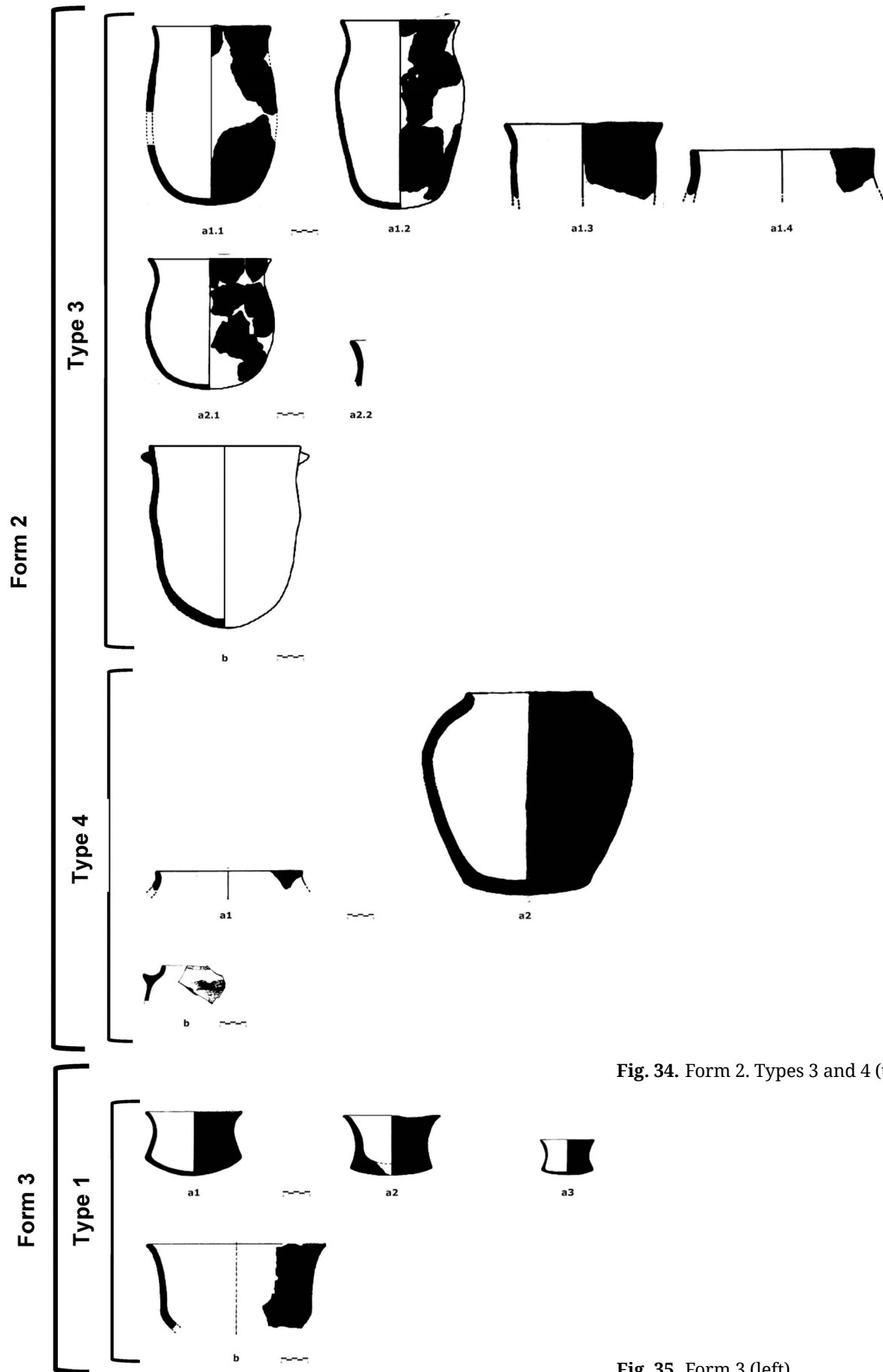


Fig. 34. Form 2. Types 3 and 4 (top).

Fig. 35. Form 3 (left).

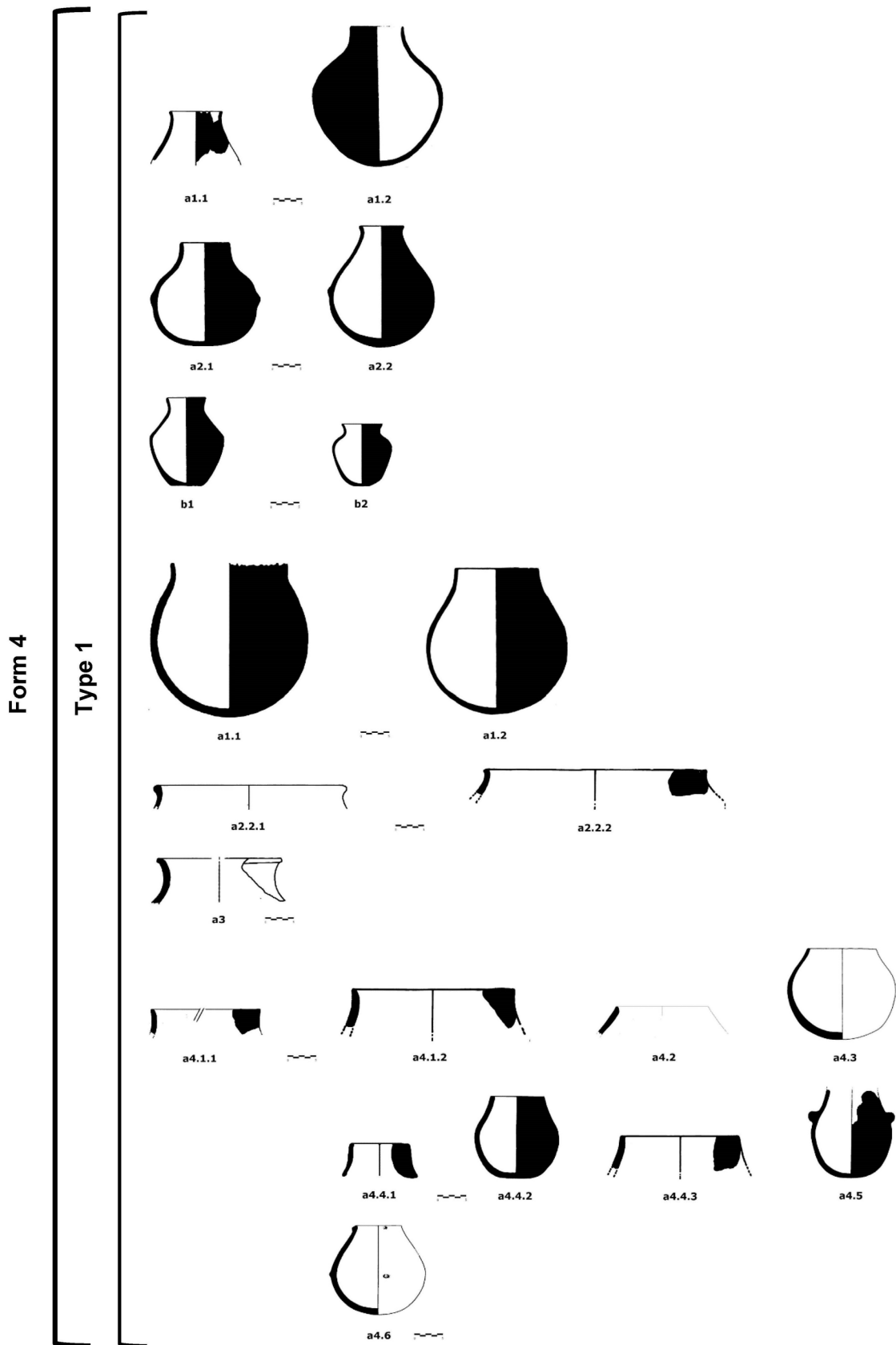


Fig. 36. Form 4. Type 1a.

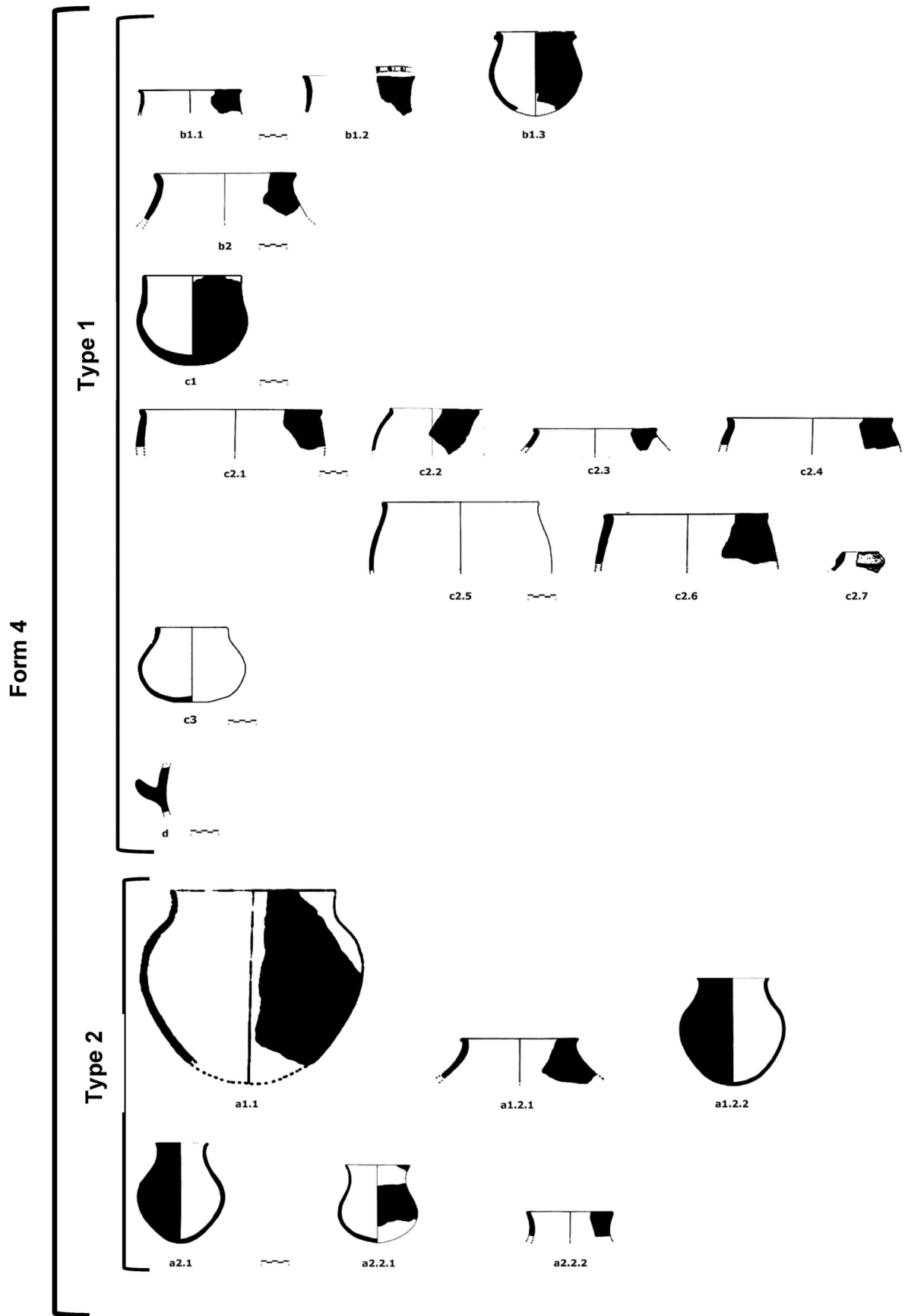


Fig. 37. Form 4. Types 1b to 2.

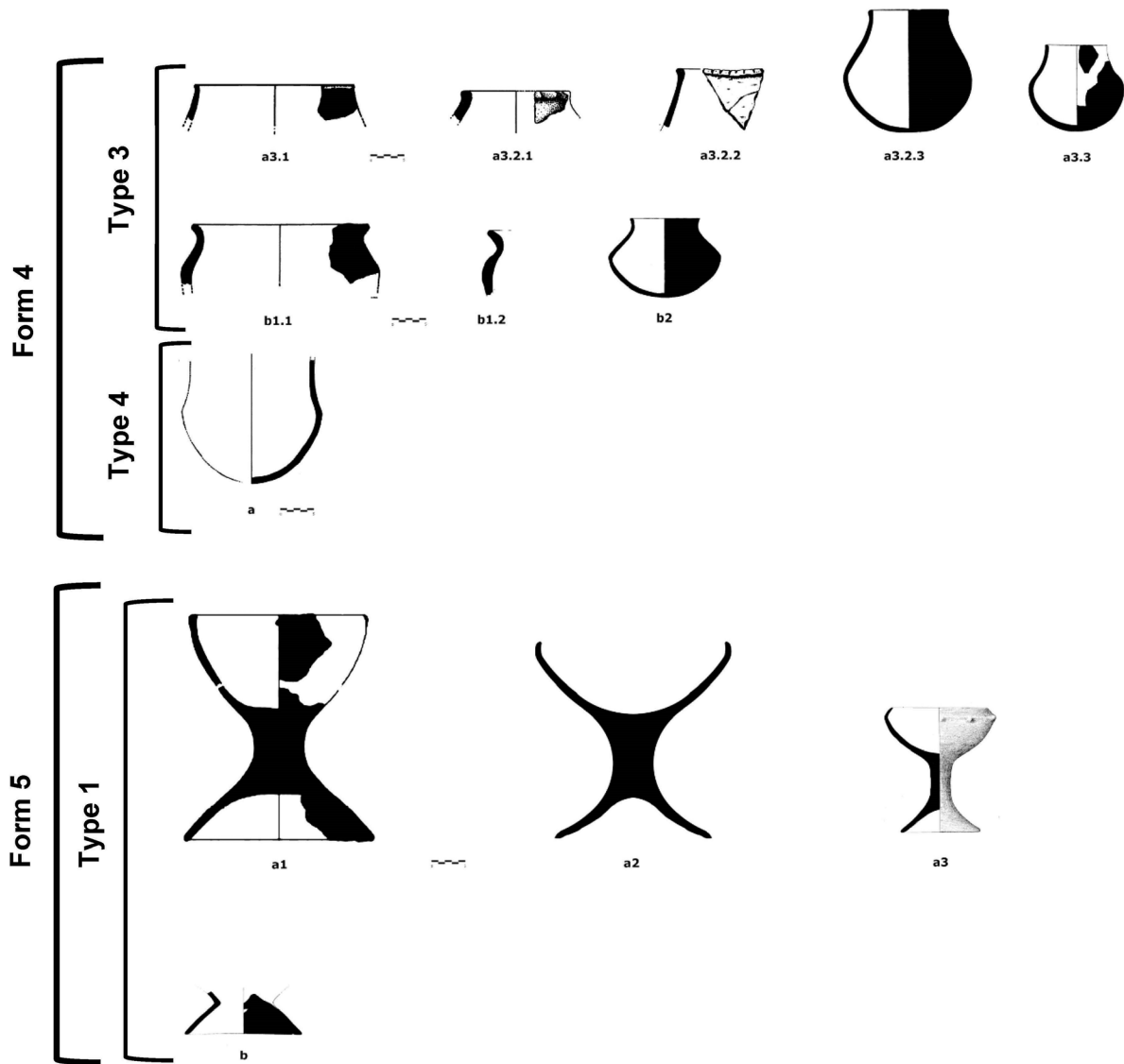


Fig. 38. Form 4. Type 3 and 4; Form 5. Type 1.

Bibliography

- Alarcón García et al. 2008:* E. Alarcón García/M. Sánchez Romero/A. Moreno Onorato/F. Contreras Cortés/L. Arboledas Martínez, Las Actividades de Mantenimiento en los Contextos Fortificados de Peñalosa. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 18, 2008, 265–296.
- Almagro Gorbea 1997:* M. Almagro Gorbea, La Edad del Bronce en la Península Ibérica. Periodización y cronología. Saguntum 30.2 (Homenaje a Milagros Gil-Masarell), 1997, 217–229.
- Aranda Jiménez et al. 2015:* G. Aranda Jiménez/S. Montón Subías/M. Sánchez Romero, The Archaeology of Bronze Age Iberia. Argaric Societies (New York 2015).
- Arribas et al. 1974:* A. Arribas/E. Pareja/F. Molina/O. Arteaga/F. Molina, Excavaciones en el poblado de la Edad del Bronce del Cerro de la Encina (Monachil, Granada). Excavaciones Arqueológicas en España 81 (Madrid 1974).

- Arteaga 1992*: O. Arteaga, Tribalización, Jerarquización y Estado en el Territorio de El Argar. *Spal. Revista de Prehistoria y Arqueología* 1, 1992, 179–208.
- Arteaga 2000*: O. Arteaga, La Sociedad Clasista Inicial y el origen del Estado en el Territorio de El Argar. *Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* 3, 2000, 121–219.
- Asquerino 1992*: M. D. Asquerino, El Pirulejo. (Priego de Córdoba). Avance de la campaña de 1991. *Antiquitas* 3, 1992, 3–7.
- Asquerino 1999*: M. D. Asquerino, Sepulturas de la Prehistoria Reciente en Priego de Córdoba. *Anuario Arqueológico de Murcia* 15, 1999, 29–39.
- Aubet Semmler et al. 1983*: M. E. Aubet Semmler/M. R. Serna/J. L. Escacena Carrasco/M. M. Ruiz Delgado, La Mesa de Setefilla. Lora del Río (Sevilla). Campaña de 1979. *Excavaciones Arqueológicas en España* 122 (Madrid 1983).
- Bartelheim et al. 2021*: M. Bartelheim/D. Chala-Aldana/M. Díaz-Zorita Bonilla, The Known Unknowns. Bronze Age Settlement and Landscape Use in Southwestern Spain. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), *Human-Made Environments. The Development of Landscapes as Resource Assemblages*. *RessourcenKulturen* 15 (Tübingen 2021) 139–162.
- Belén et al. 2000*: M. Belén/R. Anglada/E. Conlin/T. Gómez/A. Jiménez, Expresiones Funerarias de la Prehistoria Reciente de Carmona (Sevilla). *Spal. Revista de Prehistoria y Arqueología* 9, 2000, 385–403.
- Blance 1971*: B. Blance, Die Anfänge der Metallurgie auf der Iberischen Halbinsel. *Studien zu den Anfängen der Metallurgie* 4 (Berlin 1971).
- Blanco 1999*: J. L. Blanco, Vías pecuarias de Andalucía. *Medio Ambiente* 32, 1999, <https://www.juntadeandalucia.es/medioambiente/portal/documents/20151/13580975/ma_32.pdf/74370053-b21e-8d8e-7619-f9dea6862dbd?t=1621599736461> (last access 13.11.2020).
- Blanco-González et al. 2018*: A. Blanco-González/K. Lillios/J. A. López-Saéz/B. L. Drake, Cultural, Demographic and Environmental Dynamics of the Copper and Early Bronze Age in Iberia (3300–1500 BC). Towards an Interregional Multiproxy Comparison at the Time of the 4.2 ky BP Event. *Journal of World Prehistory* 31.1, 2018, 1–79.
- Borgatti et al. 2002*: S. P. Borgatti/M. G. Everett/L. C. Freeman, *Ucinet 6 for Windows. Software for Social Network Analysis* (Harvard 2002).
- Caballero Cobos 2014*: A. Caballero Cobos, Vías de comunicación en las comarcas de Baza y Huéscar. Una aproximación histórico-arqueológica desde la prehistoria reciente a la edad media (PhD-Thesis Universidad de Granada 2014).
- Cardenete López et al. 1992*: R. Cardenete López/M. T. Gómez Saucedo/A. Jiménez Hernández/R. Lineros Romero/I. Rodríguez Rodríguez, Excavaciones Arqueológicas de Urgencia en el Solar de la Plaza de Santiago Nº 1. *Anuario Arqueológico de Andalucía* 1990.III, 1992, 488–497.
- Carmona Ávila 1997*: R. Carmona Ávila, Los Cortijillos de la Sierra (Priego De Córdoba). I. A. U. En dos Tumbas de la Edad del Bronce Expoliadas. *Anuario Arqueológico de Andalucía* 1993.III, 1997, 215–218.
- Carmona Ávila 1999*: R. Carmona Ávila/A. Moreno Rosa/J. C. Vera Rodríguez/D. Luna Osuna/B. Gavilán Ceballos/A. Mollna Expósito, La cueva de Los Mármoles (Priego de Córdoba). Análisis de resultados de una prospección arqueológica superficial. *Antiquitas* 10, 1999, 5–24.
- Caro Bellido 2008*: A. Caro Bellido, *Diccionario de términos cerámicos y de alfarería* (Cádiz 2008).
- Caro Bellido et al. 1987*: A. Caro Bellido/P. Acosta Martínez/J. L. Escacena Carrasco, Informe sobre la prospección arqueológica con sondeo estratigráfico en el solar de la Calle Alcazaba (Lebrija-Sevilla). *Anuario Arqueológico de Andalucía* 1986.II, 1987, 168–174.

- Carrillero Millán/Martínez Fernández 1985*: M. Carrillero Millán/G. Martínez Fernández, El Yacimiento de Guta y la prehistoria reciente de la Campiña cordobesa. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 10, 1985, 187–223.
- Carrillo García 2018*: J. A. Carrillo García, El Argar y lo Exógeno. Rasgos comunes e interacciones con relación al Mediterráneo y Europa (MA-Thesis Universidad Nacional de Educación a Distancia Madrid 2018).
- Castillo et al. 1990*: J. L. Castillo/J. C. Lara/C. Choclán, Excavación arqueológica de urgencia en el entorno del castillo de Baños de la Encina (Jaén). Anuario Arqueológico de Andalucía 1988.III, 1990, 191–196.
- Chala-Aldana 2020*: D. Chala-Aldana, The Full Bronze Age in the Middle and Low Guadalquivir, a Landscape of Resources (PhD-Thesis University of Tübingen 2020).
- Conolly/Lake 2006*: J. Conolly/M. Lake, Geographical Information Systems in Archaeology. Cambridge Manuals in Archaeology (Cambridge 2006).
- Contreras Cortés 1986*: F. Contreras Cortés, Aplicación de métodos estadísticos y analíticos a los complejos cerámicos de la Cuesta del Negro (Purullena, Granada) (PhD-Thesis Universidad de Granada 1986).
- Contreras Cortés et al. 1987a*: F. Contreras Cortés/F. Nocete Calvo/M. Sánchez Ruiz, Análisis Histórico de las Comunidades de la Edad del Bronce de la Depresión Linares-Bailén y Estribaciones Meridionales de la Sierra Morena. Sondeo Estratigráfico en el Cerro de Plaza de Armas de Sevilleja (Espeluy, Jaén). Anuario Arqueológico de Andalucía 1985.II, 1987, 141–149.
- Contreras Cortés et al. 1987b*: F. Contreras Cortés/F. Nocete Calvo/M. Sánchez Ruiz, Primera campaña de excavaciones en el yacimiento de la Edad del Bronce de Peñalosa (Baños de La Encina, Jaén). Anuario arqueológico de Andalucía 1986.II, 1987, 342–352.
- Contreras Cortés et al. 1990*: F. Contreras Cortés/F. Nocete Calvo/M. Sánchez Ruiz, Primera campaña de excavaciones en el yacimiento de la Edad del Bronce de Peñalosa (Baños de La Encina, Jaén). Anuario Arqueológico de Andalucía 1987.II, 1990, 252–261.
- Crespo García/C. Pérez Bareas 1990*: J. M. Crespo García/C. Pérez Bareas, Prospecciones Arqueológicas Superficiales en el Termino Municipal de Orcera. Anuario Arqueológico de Andalucía 1987.III, 1990, 329–337.
- De La Torre Peña/Aguayo de Hoyos 1979*: F. De La Torre Peña/P. Aguayo De Hoyos, La Edad del Bronce en Alcalá La Real (Jaén). Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 4, 1979, 133–166.
- Delgado Fernández/Vera Rodríguez 1996*: M. R. Delgado Fernández/J. C. Vera Rodríguez, Estudio y revisión cronológica de los yacimientos de ‘la Fuente del Río’ y ‘La Veleña’ (Cabra). A propósito del paso del III al II milenio a.C. en el SE de Córdoba. Antiquitas 7, 1996, 35–44.
- Domínguez Berenjeno/Fernández 2008*: E. Domínguez Berenjeno/A. V. Fernández, Actividad Arqueológica puntual en la Cueva del Vaquero. Anuario Arqueológico de Andalucía (Sección Sevilla), 2008, 5845–5859.
- Ejstrud 2005*: B. Ejstrud, Cost Surface Analysis and Roads. A Comparison. In: J. F. Berger/F. Bertoncello/F. Braemer/G. Davtian/M. Gazenbeek (eds.), Temps et espaces de l’homme en société. Analyses et modèles spatiaux en archéologie. Actes des XXVe Rencontres internationales d’Archéologie et d’Histoire d’Antibes (Antibes 2005) 135–139.
- Escacena Carrasco 1980*: J. L. Escacena Carrasco, Contribución a la carta arqueológica del Guadalquivir. Los rebordes ribereños del Aljarafe y los Alcores (Sevilla 1980).
- Escacena Carrasco/Berriatúa Hernández 1985*: J. L. Escacena Carrasco/N. Berriatúa Hernández, El Berrueco de Medina Sidonia (Cádiz). Testimonios de una posible expansión argárica al oeste. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 10, 1985, 225–242.

- Escacena Carrasco/García Rivero 2018*: J. L. Escacena Carrasco/D. García Rivero, Transición versus ruptura. El paso del Campaniforme al Bronce Antiguo en el Cerro de San Juan. In: J. L. Escacena Carrasco/Á. Gómez-Peña/L. G. Pérez-Aguilar (eds.), CAURA. Arqueología en el estuario del Guadalquivir. Spal. Monografías Arqueología 26 (Sevilla 2018) 153–179.
- Fernández Chicarro 1946*: C. Fernández Chicarro, La copa argárica del Museo Arqueológico Provincial de Sevilla. Archivo Español de Arqueología 70, 1946, 1–2.
- Fernández/Ruiz Mata 1976*: F. Fernández/D. Ruiz Mata, Los Enterramientos en Cistas del Cortijo de Chichina. Trabajos de Prehistoria 33, 1976, 351.
- García Rivero/Escacena Carrasco 2015*: D. García Rivero/J. L. Escacena Carrasco, Del Calcolítico al Bronce Antiguo en el Guadalquivir inferior. El cerro de San Juan (Coria del Río, Sevilla) y el ‘Modelo de Reemplazo’. Zephyrus. Revista de prehistoria y arqueología 76, 2015, 15–38.
- García Sanjuán 1997*: L. García Sanjuán, Segunda Intervención en la Necrópolis de la Edad del Bronce de La Traviesa (Almaden de la Plata, Sevilla). Anuario Arqueológico de Andalucía 1993.III, 1997, 619–634.
- García Sanjuán 1998*: L. García Sanjuán (ed.), La Traviesa. Ritual funerario y jerarquización social en una comunidad de la Edad del Bronce de Sierra Morena occidental. Spal. Monografías Arqueología 1 (Sevilla 1998).
- García Sanjuán 1999*: L. García Sanjuán, Los orígenes de la estratificación social. Patrones de desigualdad en la Edad del Bronce del Suroeste de la Península Ibérica (Sierra Morena Occidental c. 1700–1100 ane/2100–1300 ANE). British Archaeological Reports. International Series S823 (Oxford 1999).
- García Sanjuán/Vargas Durán 1995*: L. García Sanjuán/M. A. Vargas Durán, Intervención de Urgencia en el Yacimiento de la Edad del Bronce de La Traviesa (Almaden de la Plata, Sevilla). Anuario arqueológico de Andalucía 1992.III, 1995, 653–665.
- Gnecco/Langebaek 2006*: C. Gnecco/C. H. Langebaek (eds.), Contra la Tiranía Tipológica en Arqueología. Una Visión desde Sur América (Bogotá 2006).
- Gómez Saucedo 2003*: M. T. Gómez Saucedo, Excavaciones Arqueológicas realizadas en el Solar de la Plazuela de Santiago Nº 6–7 de Carmona (Sevilla). Anuario Arqueológico de Andalucía 2000.III-2, 2003, 1245–1256.
- González Marcén 1994*: P. González Marcén, Cronología del grupo argárico. Revista d’Arqueologia de Ponent 4, 1994, 7–46.
- Heras y Martínez 1992*: C. M. Heras y Martínez, Glosario terminológico para el estudio de las cerámicas arqueológicas. Revista Española de Antropología Americana 22, 1992, 9–34.
- Hinz et al. 2019*: M. Hinz/J. Schirmacher/J. Kneisel/C. Rinne/M. Weinelt, The Chalcolithic–Bronze Age Transition in Southern Iberia under the Influence of the 4.2 kyr Event? A Correlation of Climatological and Demographic Proxies. Journal of Neolithic Archaeology 21, 2019, 1–26.
- Hitos Urbano 1990*: M. Hitos Urbano, Intervención arqueológica de urgencia en la Necrópolis de Valdearenas (Iznájar, Córdoba). Anuario Arqueológico de Andalucía 1987.III, 1990, 188–196.
- Hunt Ortíz 2012*: M. A. Hunt Ortíz, Intervenciones Arqueológicas en el Área del Proyecto Minero Cobre las Cruces (1996–2011). De la Prehistoria a la Época Contemporánea (Provincia de Sevilla, España) (Sevilla 2012).
- Hurtado Pérez/Amores 1984*: V. Hurtado Pérez/F. Amores, El Tholos de las Canteras y los enterramientos del Bronce en la necrópolis de El Gandul (Alcalá de Guadaira, Sevilla). Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 9, 1984, 147–174.
- Hurtado Pérez et al. 2011*: V. Hurtado Pérez/L. García Sanjuán/M. A. Hunt Ortíz, El Asentamiento de El Trastejón (Huelva). Investigaciones en el marco de los procesos sociales y culturales de la Edad del Bronce en el suroeste de la Península Ibérica (Sevilla 2011).

- Junta de Andalucía 1987*: Junta de Andalucía, Inventario de yacimientos arqueológicos de la Provincia de Córdoba. Castillo de Aguilar. Archivo Central de la Consejería de Cultura (Sevilla 1987).
- Junta de Andalucía 2020*: Junta de Andalucía, Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible, Caracterización del Paisaje mediante Categorías, Áreas y Ámbitos Paisajísticos, <http://www.juntadeandalucia.es/medioambiente/site/porta/web/menuitem.7e1cf46ddf59bb227a9ebe205510e1ca/?vgnnextoid=1aff37cbaef67310VgnVCM1000001325e50aRCRD&vgnnextchannel=239ae628e4637310VgnVCM2000000624e50aRCRD&lr=lang_es> (last access 13.11.2020).
- Klein 1985*: J. Klein, La Mesta. Estudio Histórico de la historia económica española 1273–1836 (Madrid 1985).
- Lillios et al. 2016*: K. T. Lillios/A. Blanco-González/B. L. Drake/J. A. López-Sáez, Mid-Late Holocene Climate, Demography, and Cultural Dynamics in Iberia. A Multi-Proxy Approach. *Quaternary Science Reviews* 135, 2016, 138–153.
- López Palomo 1993*: L. A. López Palomo, Calcolítico y Edad del Bronce al sur de Córdoba. Estratigrafía en Monturque (Córdoba 1993).
- Lull 1983*: V. Lull, La cultura de El Argar. Un modelo para el estudio de las formaciones económico-sociales prehistóricas (Madrid 1983).
- Lull/Estévez 1986*: V. Lull/J. Estévez, Propuesta metodológica para el estudio de las necrópolis argáricas. In: Junta de Andalucía/Consejería de Cultura (eds.), Homenaje a Luis Siret (1934–1984) (Sevilla 1986) 441–452.
- Lull et al. 2010*: V. Lull/R. Micó/C. Rihuete Herrada/R. Risch, Metal and Social Relations of Production in the 3rd and 2nd Millennia B. C. E. in the Southeast of the Iberian Peninsula. *Trabajos de Prehistoria* 67.2, 2010, 323–347.
- Lull et al. 2013*: V. Lull/R. Micó/C. Rihuete Herrada/R. Risch, The Iberian Peninsula during the Bronze Age. In: A. Harding/H. Fokkens (eds.), *The European Bronze Age* (Oxford 2013) 594–616.
- Maluquer de Motes 1974*: J. Maluquer de Motes, La Estratigrafía prehistórica de Hornos de Segura (Jaén). *Pyrenae* 10, 1974, 43–66.
- Márquez 1987*: C. Márquez, Excavación de urgencia en el Castillo de Monturque (Córdoba) en 1985. *Anuario Arqueológico de Andalucía* 1985.III, 1987, 123–124.
- Martín de la Cruz 1987*: J. C. Martín de la Cruz, El Llanete de los Moros. Excavaciones Arqueológicas en España 151 (Madrid 1987).
- Molina et al. 1978*: F. Molina/F. de la Torre/T. Nájera/P. Aguayo/L. Saéz, La Edad del Bronce en el Alto Guadalquivir. Excavaciones en Úbeda. *Boletín del Instituto de Estudios Giennenses* 95, 1978, 37–58.
- Moreno Onorato et al. 2012*: M. A. Moreno Onorato/E. Alarcón García/F. Contreras Cortés, La metalurgia y otras actividades de mantenimiento en una casa argárica. El complejo estructural XVIa de Peñalosa (Baños de la Encina, Jaén). *Antiquitas* 24, 2012, 95–116.
- Moy 2019*: R. M. Moy, Fluid Typologies. A Critical Examination of Ceramic Methods from Mai Adrasha, Ethiopia (PhD-Thesis University of California Los Angeles 2019).
- Murillo Redondo 1990*: J. F. Murillo Redondo, Estado de la cuestión sobre el poblamiento durante el calcolítico y la edad del bronce en las Subbéticas Cordobesas. *Anales de Arqueología Cordobesa* 1, 1990, 53–80.
- Murrieta Flores et al. 2011a*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Antes de los mapas. Navegación y orientación terrestre en la Prehistoria Reciente Ibérica. *Boletín del Instituto Andaluz del Patrimonio Histórico* 19.77, 2011, 85–88.

- Murrieta Flores et al. 2011b*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Movilidad, trashumancia y paisaje prehistórico. Estudio del paisaje arqueológico de Almadén de la Plata, Andalucía a través de un SIG. In: V. Mayoral Herrera/S. Celestino Pérez (eds.), Tecnologías de información geográfica y análisis arqueológico del territorio. Actas del V Simposio Internacional de Arqueología de Mérida (Mérida 2007). Anejos del Archivo Español de Arqueología 59 (Mérida 2011) 411–423.
- Nocete 1988*: F. Nocete, El análisis de las relaciones centro/periferia en el Estado de la primera mitad del segundo milenio a.n.e. en las campiñas del alto Guadalquivir: la frontera. *Arqueología espacial* 13, 1988, 37–61.
- Nocete 2001*: F. Nocete, Tercer milenio antes de nuestra era. Relaciones y contradicciones centro/periferia en el valle del Guadalquivir (Barcelona 2001).
- Ojeda Calvo 1990*: R. Ojeda Calvo/I. Santana Falcon/A. Garcia Gomez, Prospeccion Arqueologica Superficial de los terrenos afectados por la Presa 'Jose Toran' en el Termino Municipal de Puebla De Los Infantes (Sevilla). *Arqueológico de Andalucía* 1988.III, 1990, 345–353.
- Parreira 2014*: R. Parreira, O Bronze do Sudoeste como entidade arqueográfica. A visibilidade dos dados empíricos e os resultados da pesquisa como produto social. In: R. Vilaça/M. Serra (eds.), *Idade do Bronze do Sudoeste: Novas perspetivas sobre uma velha problemática* (Coimbra 2014) 13–24.
- Pellicer Catalán/Hurtado Pérez 1987*: M. Pellicer Catalán/V. Hurtado Pérez, Excavaciones en la Mesa de El Gandul (Alcalá de Guadaíra, Sevilla). *Anuario Arqueológico de Andalucía* 1986.II, 1987, 338–341.
- Perales 2008*: J. N. Perales/A. González Herrera/M. F. García Cuevas, Actividad Arqueológica en la Parcela RU 11–2, del SUNP-1, de la Z.A.M.B. *Anuario Arqueológico de Andalucía* (Sección Jaén), 2008, 3616–3617.
- Pérez Bareas/Sánchez Susi 1999*: C. Pérez Bareas/R. Sánchez Susi, Intervención Arqueológica en Marroquíes Bajos, (Jaén). Parcela E 2–4 (Sector Ua23). *Anuario Arqueológico de Andalucía* 1995.III, 1999, 271–287.
- Ramos et al. 2005*: J. Ramos Muñoz/M. Pérez Rodríguez/S. Domínguez-Bella, Las sociedades clasistas iniciales en la banda atlántica de Cádiz (III–II milenios a.n.e). La explotación de los recursos líticos. *Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* 7, 2004/2005, 51–78.
- Rodríguez 1999*: I. Rodríguez, Excavaciones en la Calle General Freire, 12. Carmona (Sevilla). *Anuario Arqueológico de Andalucía* 1995.III, 1999, 522–527.
- Román Rodríguez 2004*: J. M. Román Rodríguez, Evidencias funerarias de la Edad del Bronce en Carmona. I.A.P. En el solar N° 1 de la Calle Torre del Oro. *Anuario Arqueológico de Andalucía* (Sección Sevilla), 2004, 1000–1004.
- Ruiz Fuentes 1999*: V. M. Ruiz Fuentes, Intervención Arqueológica de Urgencia en Eras del Alcázar (Úbeda, Jaén). *Anuario Arqueológico de Andalucía* 1995.III, 1999, 301–316.
- Ruiz-Lara 1987*: D. Ruiz-Lara, Calcolítico y Edad del Bronce en la Campiña de Córdoba. Aproximación a su estudio. *Estudios de Prehistoria Cordobesa* 2, 1987, 61–88.
- Ruiz-Lara/Murillo Redondo 1992*: M. D. Ruiz-Lara/J. F. Murillo Redondo, Aproximación al Bronce Antiguo y Pleno en el Sureste de la Campiña Cordobesa. Los Yacimientos del Cerro del Castillo de Aguilar y de Zóñar. *Actas de Arqueología Cordobesa* 3, 1992, 9–35.
- Santana Falcon 1990*: I. Santana Falcon, Excavación de Urgencia de una Estructura Siliforme de Enterramiento en el Cortijo de María Luisa (Cantillana, Sevilla). *Anuario Arqueológico de Andalucía* 1988.III, 1990, 283–284.
- Schubart 1974*: H. Schubart, La cultura del Bronce del sudoeste peninsular. Distribución y definición. *Ampurias* 34, 1974, 345–370.

- Schubart/Arteaga 1986*: H. Schubart/O. Arteaga, Fundamentos arqueológicos para el estudio socio-económico y cultural de el área de El Argar. In: Junta de Andalucía/Consejería de Cultura (eds.), Homenaje a Luis Siret (1934–1984) (Sevilla 1986) 289–307.
- Schüle 1980*: W. Schüle, Orce und Galera. Zwei Siedlungen aus dem 3. bis 1. Jahrtausend v. Chr. im Südosten der Iberischen Halbinsel I. Übersicht über die Ausgrabungen 1962–1970 (Mainz am Rhein 1980).
- Segovia Fernández 2004*: A. M. Segovia Fernández, Introducción a la prehistoria de Cabra del Santo Cristo. *Sumuntán* 21, 2004, 115–128.
- Senna Martinez et al. 1984*: J. C. Senna Martinez/M. de F. Da Silva García/M. J. De Oliveira Rosa, Contribuições para uma tipologia da olaria do Megalitismo das Beiras. *Olaría da Idade do Bronze (I)*. *Clio. Arqueología* 1, 1984, 105–138.
- Serrano Peña 1999*: J. L. Serrano Peña, Informe de la Intervención Arqueológica de Urgencia en el Solar Juanito el Practicante No 5 de Jaén. *Anuario Arqueológico de Andalucía 1995.III*, 1999, 246–249.
- Sierra Alonso 1993*: F. Sierra Alonso, Excavaciones de urgencia en la Necrópolis de Canama. *Anuario Arqueológico de Andalucía 1991.III*, 1993, 467–475.
- Tarradell 1950*: M. Tarradell, La península Ibérica en la época del Argar. In: Museo Arqueológico de Murcia (ed.), I Congreso Nacional de Arqueología (Almería, 1949) (Almería 1950) 72–84.
- Viana 1953*: A. Viana/J. Formosinho/O. V. Ferreira, Algumas notas sobre o Bronze Mediterrânico do Museu Regional de Lagos. *Zephyrus. Revista de prehistoria y arqueología* 4, 1953, 97–117.
- Wheatley et al. 2010*: D. W. Wheatley/L. García Sanjuán/P. A. Murrieta Flores/J. Márquez Pérez, Approaching the Landscape Dimension of the Megalithic Phenomenon in Southern Spain. *Oxford Journal of Archaeology* 29.4, 2010, 387–405.
- Wilkinson 2014*: T. C. Wilkinson, Tying the Threads of Eurasia. *Trans-Regional Routes and Material Flows in Transcaucasia, Eastern Anatolia and Western Central Asia, c. 3000–1500 BC* (Leiden 2014).
- Zafra de la Torre 1991*: N. Zafra de la Torre, Excavaciones Arqueológicas en el Cerro del Alcazar (Baeza, Jaén), Campaña 1989. Informe Previo. *Anuario Arqueológico de Andalucía 1989.III*, 1991, 328–337.
- Zafra de la Torre/Pérez Bareas 1992*: N. Zafra de la Torre/C. Pérez Bareas, Excavaciones Arqueológicas en el Cerro del Alcazar (Baeza, Jaén), Campaña de 1990. Informe preliminar. *Anuario Arqueológico de Andalucía 1990.III*, 1992, 294–303.

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Connectivity, Interaction and Mobility during the Copper and Bronze Age in Southwestern Spain

Keywords: Copper Age, Bronze Age, GIS, mobility, livestock paths, Least Cost Paths (LCPs)

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Abstract

The application of GIS techniques brings significant advantages in tracking human and animal movements in past contexts. Therefore, in this work the ancient trade routes will be examined in connection with the Chalcolithic and Bronze Age sites from southwestern Spain in order to understand, based on spatial techniques, whether those sites were already connected, and interaction was established. In total 50 sites dating to both periods located in the provinces of Seville, Huelva, Córdoba and Badajoz in southern Iberia have been analysed. Results showed that, effectively, sites were already connected in prehistory and three major possible routes have been identified in the Sierra Morena and the Guadiana and Guadalquivir valleys that were used during both periods.

Introduction

The link of prehistoric sites to ancient routes has been of interest for the past 40 years in Iberia (Chapman 1979; Davidson 1980; Walker 1983; Cara Barrionuevo/Rodríguez López 1987; Galán Domingo/Ruiz-Gálvez 2001) and specifically the investigation of transhumance in prehistoric periods (Fernández Mier/Tente 2018; Carvalho et al. 2017; Rojo-Guerra et al. 2020).

During the last years some effort was made towards the application of spatial analysis of the territory to investigate the link between megalithic monuments and historic routes (Fairén Jiménez et al. 2006; Delibes de Castro/Romero Carnicero 1992; Rojo-Guerra et al. 2014). In the case of southwestern Spain, the use of spatial techniques to understand the connection of megalithic monuments to historical transhumance routes was investigated at the foothills of the Sierra Morena (Murrieta Flores 2007; 2011; 2012; Murrieta Flores et al. 2011a; 2011b; 2012; Wheatley et al. 2010). Since the results were very promising (Murrieta Flores 2012), there seems to be an association of those prehistoric sites to historical routes. In addition, some efforts in western Iberia, just on the northern flanks of the Sierra Morena, could demonstrate some sort of interaction during the Bronze Age (Blanco González/Esparza Arroyo 2019).

The aim of this work is to close the gap between previous studies, not only geographically but also methodologically, using additional variables to estimate the degree of connectivity and interaction, and therefore mobility from the Copper to the Bronze Age in southwestern Iberia.

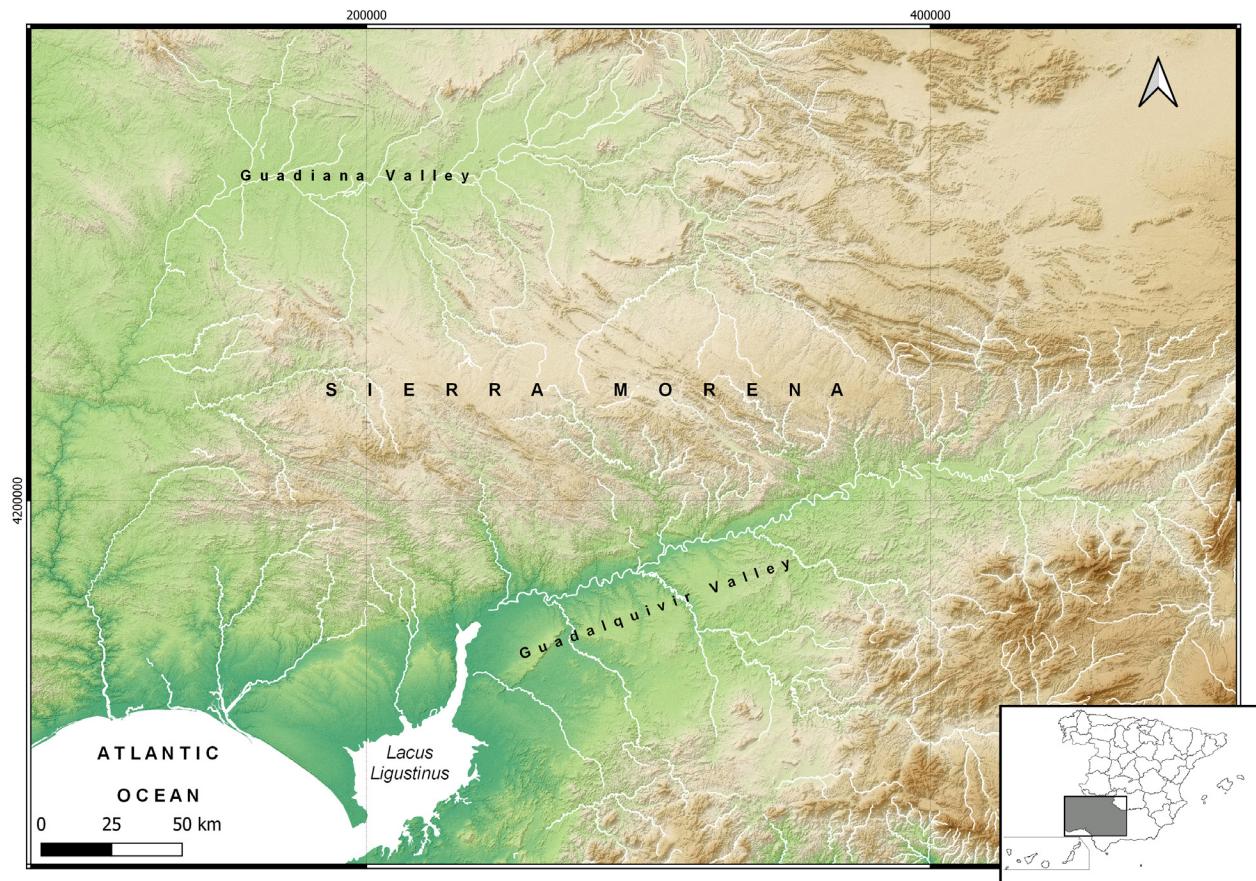


Fig. 1. Map of the study area with the three different areas: Guadiana valley, Sierra Morena and Guadalquivir valley.

Southwestern Iberia: The Guadalquivir and the Guadiana Valleys

The Lower Guadalquivir basin is located between the Iberian Massif and the Baetic system. This area includes three different elements within the landscape: 1) the Sierra Morena, 2) the Guadalquivir valley, and 3) the Sub-Baetic mountain ridge (Valdés Castrillón et al. 1987). Regarding the objectives of this work, the focus will be only on the Sierra Morena and the Lower Guadalquivir valley, encompassing the provinces of Huelva, Cádiz, Seville and Córdoba. The Sierra Morena occupies the northern area of the provinces of Huelva, Seville and Córdoba. Its altitude is around 700m a.s.l. of a very diverse geological composition (Galán et al. 2008) with very rich mineral ores. From an edaphological point of view, the main soil types in the Guadalquivir basin are luvisols and cambisols, which are fertile and suitable for

agricultural practices. In the case of luvisols, they are concentrated in low hills associated with oaks (IUSS Working group WRB 2007). The quality of the soils in the Sierra Morena makes them unsuitable for agriculture, but they are very appropriate for animal husbandry practices. The climate is of a continental Mediterranean type, characterised by dry summers and mild, rainy winters. The natural forest would correspond to a *maquia* of high scrub vegetation, but due to the oceanic influence, the vegetation includes riparian forests and basophilic forests of holm oaks and occasional wild olives. Carob trees are also present as well as a high variety of high and low scrubs (Rivas Martínez 1988; Asensi/Díez Garretas 1987; Mudarra Gómez 1988; Serruto Bellido/Villamil Prieto 1990). The area of the Guadalquivir valley is quite special, because during Antiquity the mouth of the Guadalquivir was located approximately 100km inland (up to the present location of Alcalá del Río) and this

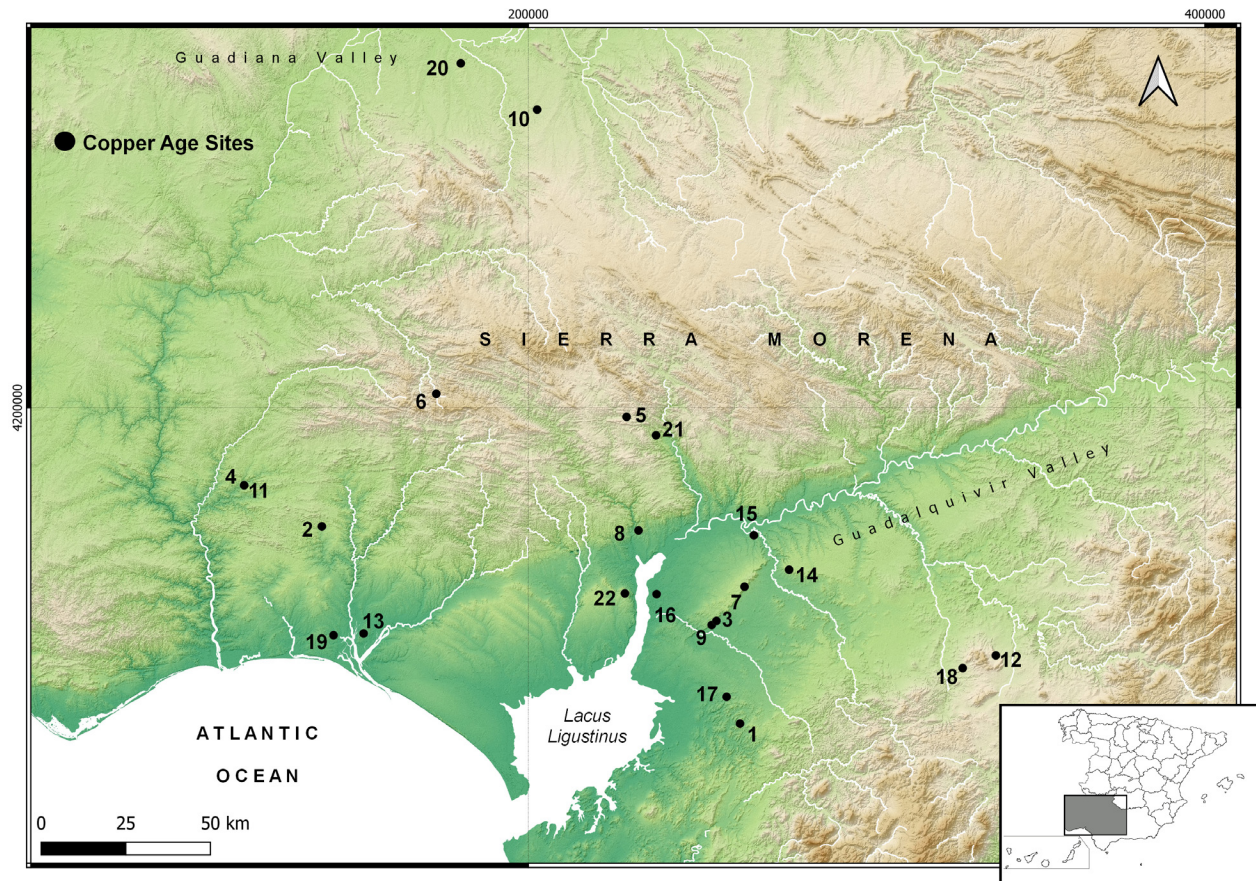


Fig. 2. Copper Age sites included in this study. Numbers here referred correspond to the list in table 1. (Scale: 1:1,250,000 EPSG 25830 UTM 30N).

area was a marsh which did not get filled up until the Late Neolithic (Borja Barrera/Borja Barrera 2016; Barragán Mallofret 2016).

The Guadiana basin is located between the two most important Cenozoic basins of southwestern Spain, the Tajo and the Guadalquivir (Tsige et al. 2020). The middle Guadiana basin is located on the southwestern central plateau of the Iberian Peninsula, including the province of Badajoz, and is characterised by a highly productive agricultural land mainly composed of quaternary and tertiary deposits.

Sites were divided into three different ecotones which correspond to the provinces of Badajoz, Huelva and Seville (fig. 1):

- Guadiana valley: Badajoz
- Sierra Morena: Badajoz (southern area), Huelva and Córdoba (northern areas of both provinces)
- Guadalquivir valley: Seville

Material and Methods

In total 50 archaeological sites were used for analysis, of which 22 sites were dated to the Copper Age (fig. 2, table 1) and 28 sites to the Bronze Age (fig. 3, table 1).

The main criteria to select those sites were first, the location, and second, the identification of the chrono-cultural period. It was a prerequisite to know whether the identification of materials and context was done through excavation or fieldwalking in order to have a clear and secure chronology assessed for both periods.

Spatial analysis criteria have been used to understand the connection and use of routes in prehistory. Therefore, the GIS procedures presented here followed the steps carried out by Chala-Aldana (this volume) to calculate the possible prehistoric paths used for moving resources along the Guadalquivir valley during the Full Bronze Age.

Site		Code	Province	Chronology	Area	Reference
Valencina-Castilleja	22	VAL	Seville	Copper Age	Middle Guadalquivir valley	Castro Martínez et al. 1996; García Sanjuán et al. 2018
El Negrón	18	NEG	Seville	Copper Age	Middle Guadalquivir valley	Cruz-Auñón Briones et al. 1993
El Gandul	9	GAN	Seville	Copper/ Bronze Age	Middle Guadalquivir valley	Hurtado Pérez/Amores Carredano 1984
Parque Miraflores	16	MIR	Seville	Copper Age	Middle Guadalquivir valley	Lara Montero et al. 2004
Loma del Real Tesoro II	15	LRT II	Seville	Copper Age	Middle Guadalquivir valley	Escudero Carrillo et al. 2017
El Amarguillo II	1	AMA	Seville	Copper Age	Middle Guadalquivir valley	Cabrero García et al. 1997
El Hediondal	8	ELHE	Seville	Copper Age	Middle Guadalquivir valley	Guisado Castejón 2011
Las Cumbres	14	LASCU	Seville	Copper Age	Middle Guadalquivir valley	Fernández Caro 1991
Carmona	3/29	CAR	Seville	Copper/ Bronze Age	Middle Guadalquivir valley	Cardenete López et al. 1990; Pellicer Catalán 2006; Román Rodríguez/Vázquez Paz 2005
La Molina	17	MOL	Seville	Copper Age	Middle Guadalquivir valley	Juárez Martín/Moreno Alonso 2010
La Pijotilla	20	PIJ	Badajoz	Copper Age	Middle Guadiana valley	Hurtado Pérez et al. 2000
Huerta Montero	10	HUE	Badajoz	Copper Age	Middle Guadiana valley	Blasco Rodríguez/Ortiz Alesón 1991
Junta de los Ríos	11	JUN	Huelva	Copper Age	Sierra Morena	Nocete Calvo 2008
Cueva de la Mora	6	CUMO	Huelva	Copper Age	Sierra Morena	Pérez Macías et al. 1990
Papauvas	19	PAPA	Huelva	Copper Age	Sierra Morena	Martín de la Cruz 1987a
Cabezo Juré	2	CAB	Huelva	Copper Age	Sierra Morena	Nocete Calvo 2006
Tholos de Palacio III	21	THO	Seville	Copper Age	Sierra Morena	García Sanjuán/Wheatley 2006
La Orden-El Seminario	13	LAORD	Huelva	Copper Age	Tierra Llana Huelva	Garrido Fernández et al. 2015
Cerro de los Vientos	4	CEVI	Huelva	Copper Age	Sierra Morena	Piñon Varela 1987
Cueva de los Covachos	5	CUCO	Seville	Copper Age	Sierra Morena	Caro Gómez et al. 2000
El Acebuchal	7	ELACE	Seville	Copper Age	Middle Guadalquivir valley	Lazarich González et al. 1995
La Morita	12	LAMO	Seville	Copper Age	Middle Guadalquivir valley	Acosta Martínez et al. 1987
Cerro del Pino I and II	32	CEPI	Seville	Bronze Age	Middle Guadalquivir valley	Ferrer Albelda et al. 2005
Celti	31	CELT	Seville	Bronze Age	Middle Guadalquivir valley	Ferrer Albelda et al. 2005

Site		Code	Province	Chronology	Area	Reference
Cueva del Vaquero	35	CUEV	Seville	Bronze Age	Middle Guadalquivir valley	Domínguez Berenjano/ Fernández 2008
Llanete de los Moros	37	LLA	Córdoba	Bronze Age	Middle Guadalquivir valley	Martín de la Cruz 1987b
Mesa Cordobesa I and II	39	MECO	Seville	Bronze Age	Middle Guadalquivir valley	Ferrer Albelda et al. 2005
Cobre las Cruces	34	CLC	Seville	Bronze Age	Middle Guadalquivir valley	Hunt Ortiz et al. 2008
Borbollón	27	BOR	Seville	Bronze Age	Middle Guadalquivir valley	Ferrer Albelda et al. 2005
Naeva	42	NAEV	Seville	Bronze Age	Middle Guadalquivir valley	Santana Falcón 1990
Cerro de la Encarnación	36	ENC	Seville	Bronze Age	Middle Guadalquivir valley	Schattner et al. 2004
Piedra Resbaladiza	44	RES	Seville	Bronze Age	Middle Guadalquivir valley	Schattner et al. 2004
Arva	25	ARVA	Seville	Bronze Age	Middle Guadalquivir valley	Remesal Rodríguez 1990
El Carrasco	30	CARRA	Seville	Bronze Age	Middle Guadalquivir valley	Ojeda et al. 1990
La Ranilla	43	RANI	Seville	Bronze Age	Middle Guadalquivir valley	Amores 1982
Monturque	41	MONT	Córdoba	Bronze Age	Middle Guadalquivir valley	López Palomo 1993
Mesa Redonda	40	MESA	Seville	Bronze Age	Middle Guadalquivir valley	Huntingford 1983
Arca	24	ARCA	Seville	Bronze Age	Middle Guadalquivir valley	Escacena-Carrasco 1980
Canama	28	CANA	Seville	Bronze Age	Middle Guadalquivir valley	Sierra Alonso 1991
Chichina	33	CHI	Seville	Bronze Age	Middle Guadalquivir valley	Fernández Gómez et al. 1976
Cortijo María Luisa	38	MARIA	Seville	Bronze Age	Middle Guadalquivir valley	Santana Falcón 1990
Cerro de San Juan	46	SANJU	Seville	Bronze Age	Middle Guadalquivir valley	García Rivero/Escacena Carrasco 2015
Setefilla	50	SET	Seville	Bronze Age	Middle Guadalquivir valley	Aubet Semmler et al. 1983
Alange	23	ALA	Badajoz	Bronze Age	Middle Guadalquivir valley	Blanco González/Esparza Arroyo 2019
El Castillo-Umbria (Alange)	49	UMB	Badajoz	Bronze Age	Middle Guadalquivir valley	Blanco González/Esparza Arroyo 2019
La Traviesa	48	TRAV	Seville	Bronze Age	Sierra Morena	García Sanjuán 1998
El Trastejón	47	TRAS	Seville	Bronze Age	Sierra Morena	Hurtado Pérez et al. 2011

Table 1. List of sites used for the analysis.

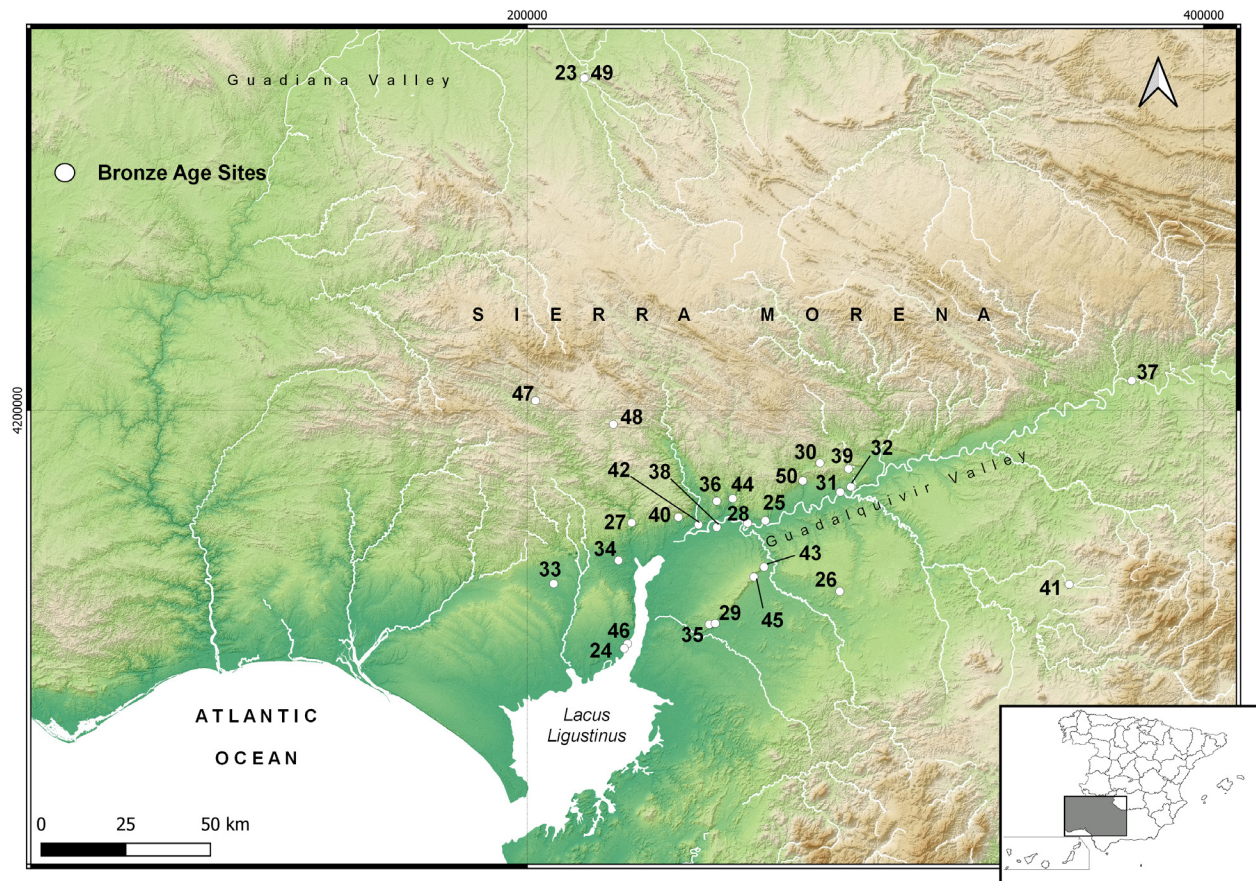


Fig. 3. Bronze Age sites included in this study. Numbers here referred correspond to the list in table 1 (Scale: 1:1,250,000 EPSG 25830 UTM 30N).

Digital resources were obtained from the CNIG¹ webpage, where a Digital Elevation Model (DEM) of the quadrants covering the study area was downloaded and placed as a layer into the Geographic Information System (GIS) software. These raster maps contain information about the height above sea level along the represented surface for each pixel (Conolly/Lake 2006). The raster downloaded covers the lower Guadalquivir valley, the adjacent Sierra Morena, and the Guadiana valley.

Within the GIS, the slope of the terrain was calculated from the DEM using one of the tools provided by the software for raster analyses, which superimposed a new layer consisting of a raster map with information about the percentage of

slope (positive, zero or negative) for each pixel of the DEM of the study area.

After adding a new layer with the locations of the sites here referred, the least cost path (LCP) between pairs of sites (from the same period) was calculated. LCPs are hypothetical routes that follow the easiest path between two locations, considering the costs of moving through a terrain with determined slope percentages (Conolly/Lake 2006). These calculated paths avoid surfaces with higher positive slopes and follow surfaces with less accumulated costs. The higher the slope, the higher the energy and cost of moving across the surface.

From these calculations, two new vector (line) layers with LCP networks of Copper and Bronze Age sites were obtained. Both layers were merged, since the analysis investigates mobility in general along the Copper and Bronze Age periods (fig. 4). Considering that the LCPs are models that represent hypothetical links between sites, it was

¹ CNIG = Centro Nacional de Información Geográfica (National Service of Geographic Information) of the Spanish Ministry of Transport, Mobility and Urban agenda.

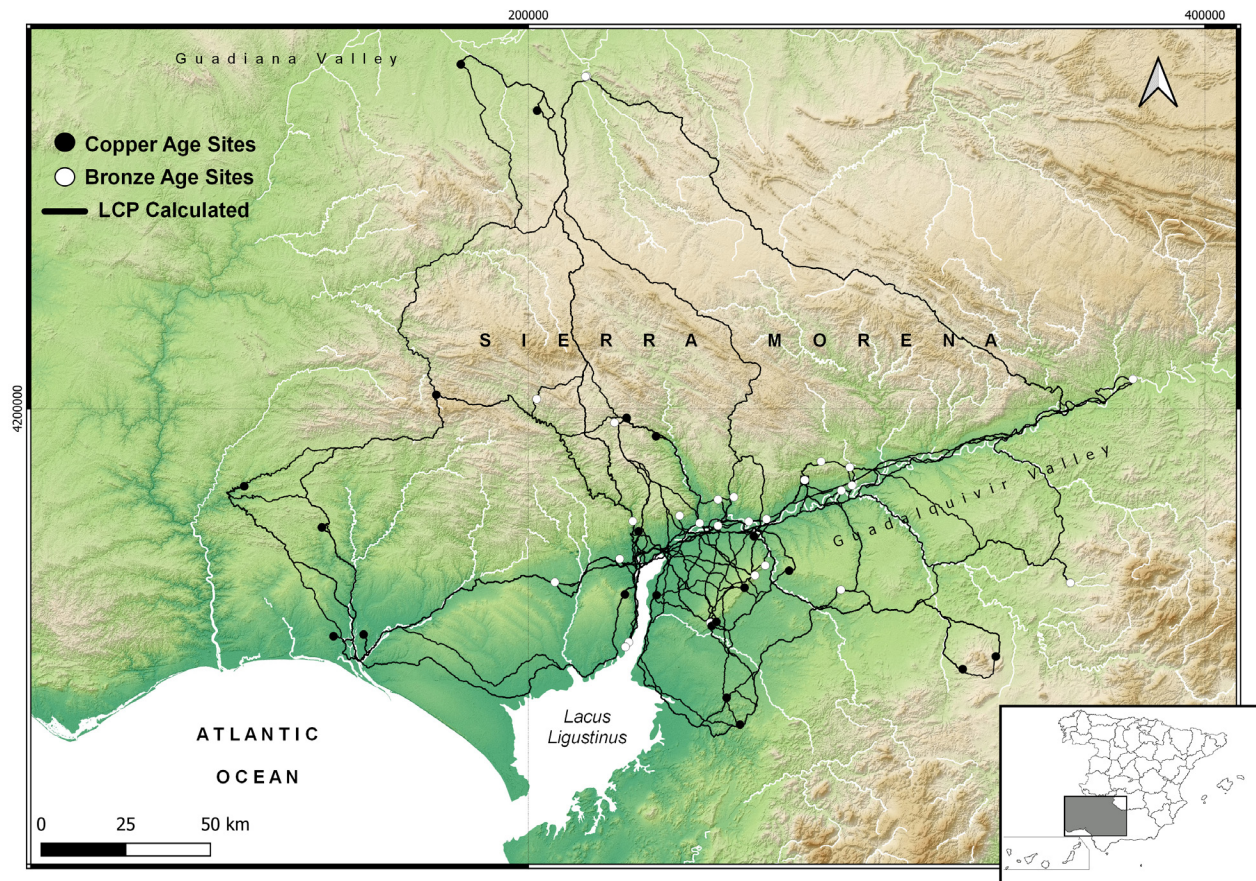


Fig. 4. LCPs calculated between pairs of Copper and Bronze Age sites respectively. Site numbers are the same as shown in fig. 2 and 3 (Scale: 1:1,250,000 EPSG 25830 UTM 30N).

necessary to identify evidence of such interactions in the real terrain.

Vector layers of current livestock paths in the provinces of Seville, Huelva and Badajoz were included in the GIS. The relationship between the location of megalithic monuments and pathways as well as herding of ovicaprines has been evidenced during the Chalcolithic and the Bronze Age (Murrieta Flores et al. 2011a; 2011b; Wheatley et al. 2010). The use of such paths has been documented since Iberian (pre-Roman) times (Klein 1985), and there is also evidence of the use of some of these routes during the Iron Age and later (Blanco 1999), as is the case of the Copper Age site of El Hediondal (Guisado Castejón 2011), located in the foothills of the Sierra Morena. It is crossed by a present-day livestock route which is an old variant of the Via de la Plata in the Roman period and the Camino de Santiago from the Middle Ages until today. Despite herding practices shifting into modern ways of moving cattle, most of these paths are

still being used today for moving mainly caprines across the Sierra Morena.

Livestock paths in Spain are protected by law since 1995 (Ley3/1995, de 23 de marzo, de vías pecuarias). The origin of this law resides in the protection of the historical routes for herding strategies and to promote their conservation and use, as well as movement through them. There were also previous attempts to protect them by law (Real Decreto de 3 de marzo de 1877, in Fairén Jiménez et al. 2006). According to their size (Blanco 1999), there are four types of livestock paths which can be seen in table 2.

Type	Size (width)
Cañadas	75m
Cordeles	37.5m
Veredas	20m
Coladas	≤15m

Table 2. Types of livestock paths.

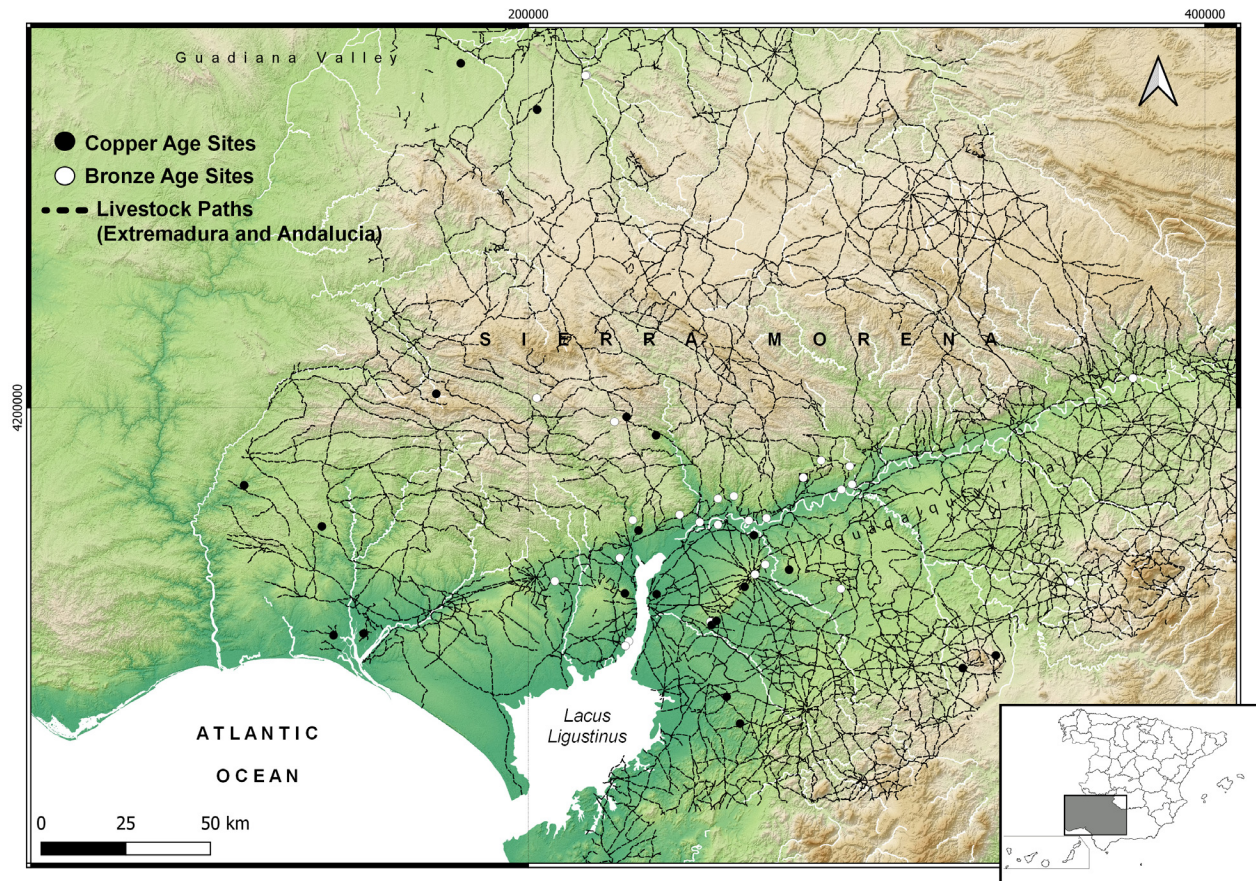


Fig. 5. Current livestock paths along the provinces of Badajoz (Extremadura), Seville and Huelva and Córdoba (Andalusia). Site numbers are the same as shown in fig. 2 and 3 (Scale: 1:1,250,000 EPSG 25830 UTM 30N).

Vector maps with livestock path networks (mapped from the real terrain) were downloaded from the geographic services of Andalusia and Extremadura (fig. 5) and the Ministry of ecological transition and demographic change of the Spanish Government.² Livestock paths were classified into the four path types (according to the metadata of each map). Besides differentiating path types, every single path inside the study area was counted.

Livestock path layers were intersected with the LCP network calculated into the GIS software. The resulting vector layer showed a series of points marking the sectors where both LCP and livestock paths coincided (Chala-Aldana, this volume). The series of points following the same direction of the

real livestock path were considered for elaborating the definitive model. Pearson's χ^2 test was performed to check if the resulting model by chance arose or not.

Results

Regarding the number of sites that were included in this analysis, there are 50 in total of which 22 are dated to the Copper Age and 28 to the Bronze Age of which two sites (Carmona and El Gandul) have a transitional chronology from the Copper to the Bronze Age reflecting both periods.

For the surface covering the study area (fig. 5), a total of 1584 livestock paths were included (table 3). After the algorithm for intersecting the livestock paths with the LCPs was calculated, a total of 407 paths intersected (fig. 6). Most of these intersections were not perpendicular but followed the same direction of the livestock path (fig. 6).

² <https://www.miteco.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/informacion-disponible/vias_pecuarias.aspx> (last access 04.03.2021).

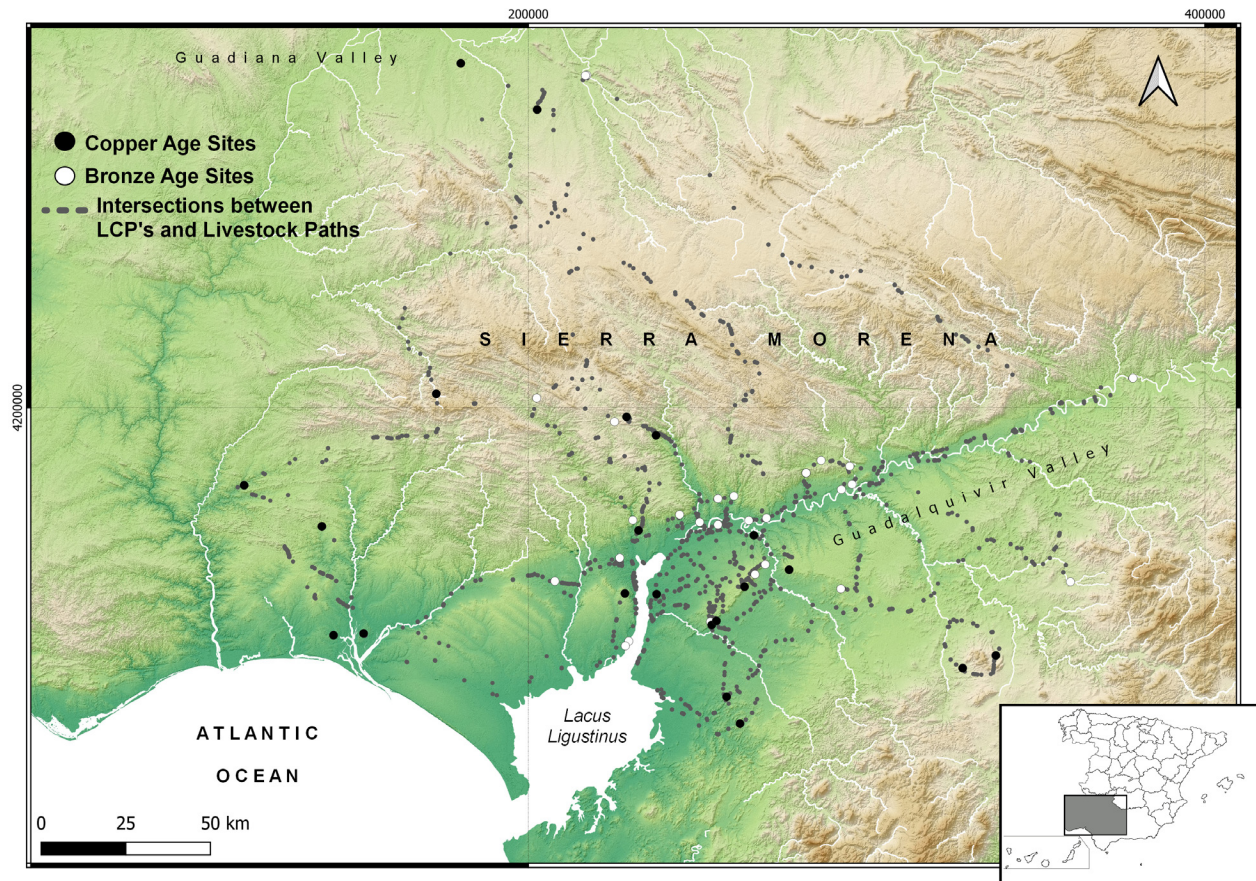


Fig. 6. Intersections between livestock paths and LCPs calculated. Site numbers are the same as shown in fig. 2 and 3 (Scale: 1:1,250,000 EPSG 25830 UTM 30N).

Livestock Path Type	N	Intersected	Expected values	Non-Intersected	Expected values
Cañadas	263	85	67.5764	178	195.424
Coladas	334	64	85.8194	270	248.181
Cordeles	304	100	78.1111	204	225.889
Veredas	683	158	175.493	525	507.507
Total	1584	407		1177	

Table 3. Contingency table with the count of livestock path types intersected and non-intersected used for Pearson's χ^2 test.

Pearson's χ^2 test shows that the model calculated with the GIS was not a product of chance, meaning that the LCPs made between pairs of sites can be spatially represented in the real livestock routes that exist today in the study area (Pearson's $\chi^2 = 24.1133$, $df=3$, $N=1584$, $P < 0.00002366$).

According to the model obtained from the intersections, five different corridors were identified during the Copper Age (fig. 7) and six during the Bronze Age (fig. 8) (supplementary data S1).

As it can be seen in fig. 7, there are five routes identified that follow these paths and link several contemporaneous sites across the Sierra Morena. The first route starts from Valencina and goes through the Aljarafe plateau towards the Sierra de Huelva (the westernmost part of the Sierra Morena). The second route starts at Valencina and goes towards the Sierra de Huelva to the Cueva de la Mora site. The third route starts in Valencina and goes through the Aljarafe plateau towards the

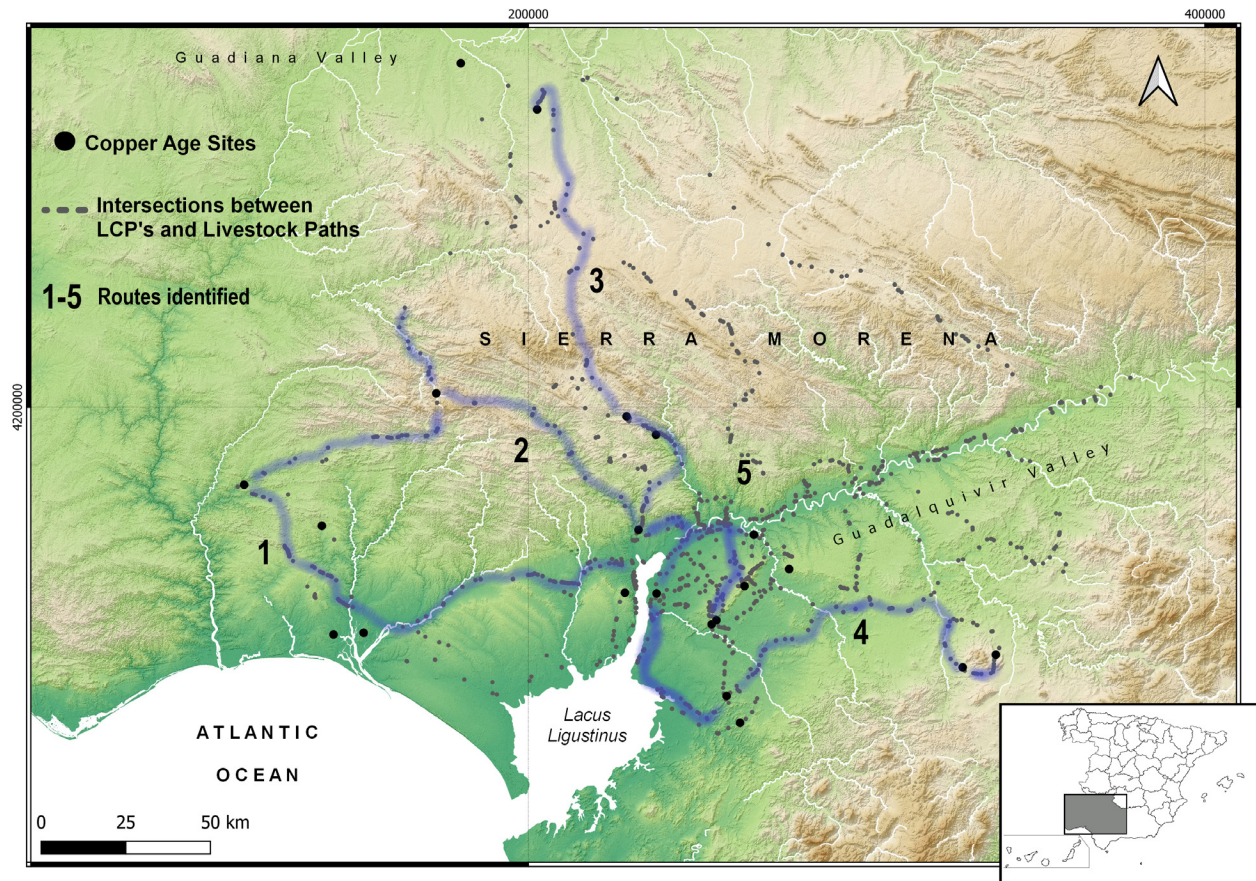


Fig. 7. Identified corridors in southwestern Iberia during the Copper Age.

archaeological site of Huerta Montero at the Guadiana valley. The fourth route starts at La Morita and goes through the Baetic system towards the Aljarafe plateau, joining Route 3 at the end. The last, Route 5 starts in Carmona and goes towards the Aljarafe plateau joining Route 4 at the end.

In fig. 8 the different routes observed for the Bronze Age period (already discussed in Chala-Aldana, this volume) can be seen. The first route started at the archaeological site of Cobre las Cruces and connected with the Aljarafe plateau and the Sierra Norte. Route 2 is the same as Copper Age Route 5. Route 3 began at Monturque and led to Los Alcores where there is connection with the site of Carmona. Route 4 started at Llanete de los Moros and was the Guadalquivir Route which ended at the Lacus Ligustinus (Chala-Aldana, this volume). Route 5 started at Arva and connected the middle Guadalquivir with the Sierra Norte. And Route 6 followed the upper Guadalquivir starting at Llanete de los Moros and terminated in the Sierra Norte at the intersection with Bronze Age Route 5.

Discussion

Although Copper and Bronze Age settlement patterns in southern Iberia are quite different, they share some peculiarities. While the Chalcolithic occupied the Guadalquivir and the Guadiana valley lowlands, the Bronze Age settlement, although rather unknown until now (Chala-Aldana, this volume; Bartelheim et al. 2021), reached into higher altitude areas towards the Sierra Morena. Despite their different settlement patterns and locations, sites were strategically located (next to routes, resources, forests, in productive lands, next to water sources, etc.) and were actually interconnected during both periods. In addition, the presumably historic Medieval routes (which are today's transhumant routes) were already in use since the Chalcolithic. It is possible that movements under the well-organised Medieval system of transhumance were not as far-reaching, neither vertically nor horizontally, and there are also possibilities that other forms of mobility were practiced (Carmona

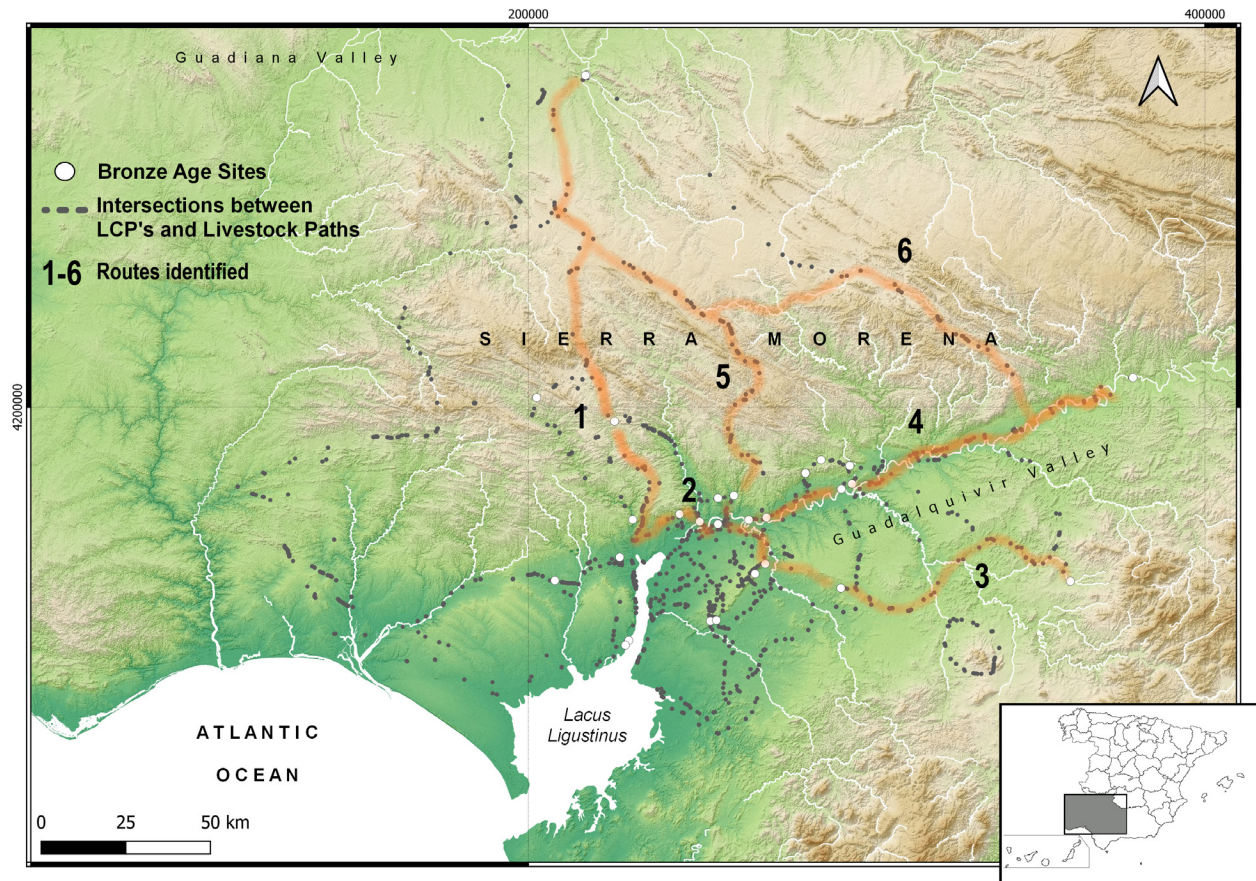


Fig. 8. Identified corridors in southwestern Iberia during the Bronze Age.

Ruiz 1993), but possibly other forms of mobility happened. One way to approach landscape archaeology is to model movement with Geographic Information Systems (GIS). Through this, it is possible to include terrain characteristics into the spatial analysis of interaction between prehistoric sites in southwest Iberia. These trade-offs, for example the costs of moving across the landscape, add to the knowledge about hypothetical routes used by people to move material and immaterial resources, among them animals, in the context of transterminance or transhumance practices, which has already been documented for antiquity (Bartelheim et al., this volume). Nevertheless, it should be said that the LCP network elaborated for this paper is not a model in itself and needs to be documented in the real terrain. GIS software helps to understand the relationship between the proposed model and the real livestock paths, some of which are still used today for moving cattle and caprines between the Guadalquivir and the Guadiana valleys. Such routes seem to originate not only

from the Iberian and Roman periods but are possibly even from older times. According to the corridors identified for each period, five for the Copper Age and six for the Bronze Age, they date back until prehistoric times. Copper and Bronze Age communities had to move and interact with other populations in the Sierra Morena. Such identified corridors (fig. 7, 8), when viewed in relation to the current livestock routes, were likely the routes used for such movements.

Some current livestock paths (at least the ones intersected by the LCPs and those known as ancient routes), could be considered as assemblages or palimpsest products of thousands of years of movement. Movement does not only mean the physical activity of changing locations; it is also the result of human-nature interaction, and understanding this as synergy with the landscape as a provider of resources for the traveller but also for the animals (e.g. water, salt, food, among others) expands the horizons of present knowledge. Following this approach, the analysis of mobility is

understood as a ResourceComplex (Hardenberg et al. 2017), which includes the people guiding the movement (comprising the animals and associated objects) who possess the adequate knowledge to carry out the husbandry practices in the form of transhumance or transterminance. In other cases, this movement might not reflect any husbandry practice at all but a trip made to certain locations for resource extraction, exchange of goods and for gathering people. The Sierra Morena is rich in resources (abiotic and biotic) which were not used for agricultural practices, therefore regarding this place as a natural corridor interconnecting the fertile Guadalquivir and Guadiana valleys seems quite plausible. Such routes could also be useful for locating prehistoric sites that have not been yet discovered, assuming that sites are already organised within the landscape and considering that most of the sites referred to in this study are very close and linked to at least one of these paths.

Digital applications, such as GIS, are useful tools for detecting prehistoric mobility and identifying it in the real terrain. Digital elevation or land cover models are easily accessible from the official webpages of geographic services, which helps archaeologists to use such information for several types of analysis involving the interaction between prehistoric people and their surrounding landscape.

It is quite interesting to note that for the Copper Age five different corridors were identified, all of them located in the westernmost part of the Guadalquivir valley and in the Sierra Morena. However, for the Bronze Age, six corridors were detected, three of which are towards eastern Andalusia (fig. 7, 8). As a result, three corridors (2, 3 and 5 for the Chalcolithic and 1, 2 and 5 for the Bronze Age) were of common use and transition for both periods, having a concentration of sites around the meadow area of Carmona (Sevilla). This is an open area of grazing and pastures and is quite favourable for the mobility of herds towards the Sierra Morena. Since this is a relatively flat and open area, suitable for the transition through the Guadalquivir valley, this was possibly a frequently transited area. This has been proven with scientific analysis since, for later periods such as the Iron Age, the results of pollen analysis discovered a highly degraded and deforested vegetation

(Llergo et al. 2007) where anthropization was a major issue, possibly due to the intensive herding strategies in this area. This has been confirmed, for example, at the Copper Age site of La Loma del Real Tesoro, located on the right bank at the confluence of the Guadalquivir and the Corbones river, which controlled a possible ford over the river Guadalquivir and is now crossed by a livestock route (Escudero Carrillo et al. 2017), where lithic resources were mainly brought from the Sierra Morena area (Escudero Carrillo 2021).

Conclusions

Regarding the mobility studies applied to the analysis of the prehistoric landscape and looking at ancient ways of interactions, spatial analysis has resulted as one of the most useful techniques to explore such movement. It allows to understand past movement as a ResourceAssemblage which involved a wide range of motions, actions and knowledge. The fact that towards the Iron Age a highly degraded and deforested vegetation was found in this region not only demonstrates that anthropization was quite high, but also that herding strategies were one of the main activities, along with agricultural practices. The fact that the Sierra Morena was not suitable for agricultural practices, speaks in favour of a need to use this area to move the herds from the valley up into the Sierra Morena.

While it has been suspected for a long time that there were connections and interactions between settlements during the Copper Age and the Bronze Age in southwest Iberia, including connections between the Guadiana and Guadalquivir valleys and the Sierra Morena, these contacts can only be demonstrated now thanks to spatial analysis. This paper has demonstrated that using spatial techniques such as GIS can be very useful to understand the character of landscapes as Resource-Complexes in prehistory and how mobility can be explored. The results of the LCP analysis of the historical routes, which are considered to be the prehistoric livestock paths in use during the Copper and the Bronze Age, indicate that sites were already strategically located and connected to each other. Therefore, of the five and six corridors

identified for the Copper and Bronze Age respectively, at least three were in use in both periods linking the Sierra and the valley.

The extent of the movement is something that cannot yet be determined and might require a multi-proxy approach using scientific techniques

such as isotope ($\delta^{18}\text{O}$ and $^{87}\text{Sr}/^{86}\text{Sr}$) analysis. Nevertheless, what is certain is that the Guadalquivir and the Guadiana valleys could have been certainly connected to the Sierra Morena through the herding strategies and that the complex of movements could be understood as a ResourceCulture.

Supplementary Data S1: List of Routes by Periods

Copper Age

Route 1 (Aljarafe–Sierra of Huelva, by the sierra foothills)

From Valencina...
Vereda Camino de los Naranjos
Cañada Real de Ayamonte a Sevilla
Vereda del Camino Viejo de la Puebla
Cordel de Portugal
Vereda del Corte del Medio
Vereda del Camino de Huelva o de pared
Vereda de la sepultura de Aguas de Miel
Vereda del Camino del Cerro
Cañada Real de Medellín o Soriana
Vereda de Almonaster a Cabeza Rubias
Vereda de los Cerreños towards Cueva de la Mora
Vereda de la Nava
Vereda de la Murtiguilla
Cordel del camino de Jerez
Colada de Rocon also towards Cueva de la Mora

Route 2 (Aljarafe–Sierra of Huelva, by Aracena)

Form Valencina...
Cordel de Guillena o de las Cañas
Vereda de Salteras
Cordel de la Cruz de la Mujer
Cordel de Guillena
Colada del Trabuco
Vereda de los contrabandistas
Cordel de las Huelvas
Vereda del Camino de Aracena o Santa Olalla
Vereda de Sevilla towards Cueva de la Mora

Route 3 (Aljarafe–Sierra Norte)

From Valencina...
Cordel de Guillena o de las Cañas
Vereda de Salteras
Vereda de Sevilla a Guillena
Vereda de Guillena a Castiblanco

Cordel de Chaparral a Almadén
Cordel de El Pedroso
Cordel de Monesterio
Cordel de Sevilla y Almadén
Vereda de La Plata
Cañada Real Leonesa
Vereda de La Senda
Colada de Usagre
Colada del Álamo
Colada de Pozo Medina
Vereda de la Calzada Romana
Vereda del Camino de Acebuchal o de Valparaiso towards Huerta Montero

Route 4 (Baetic System–Aljarafe)

From La Morita...
Vereda de Sierra Yeguas
Cañada Real de Sevilla towards El Negrón
Cordel de Fuentes a Gilena
Cañada Real de Carril Ancho
Vereda de Pozo del Rey
Cañada Real de Don Francisco
Cañada Real de Friillas
Cordel de Pavia
Cordel de Écija
Cañada Real de Sevilla
Vereda de Mariserrana
Cañada de Piedra Hincada
Cordel de la Fuente de la Higuera
Cañada Real del Prado del Gallego
Cañada Real de la Romana (towards the coast of the Lacus Ligustinus)
Cañada Real de los Puntales
Cañada Real de la Isla Menor
Cañada Real de La Armada
Cañada Real del Bodegón de las Cañas
Cañada Real de Córdoba a Sevilla
Cordel de Brenes

Vereda del Bodegón de las Cañas
 Cordel de Sevilla
 Colada de Burguillos
 Cañada Real de Huelva a Córdoba
 Vereda de Guillena a Castiblanco (linking Route 3)

Route 5 (Alcores–Aljarafe)

From Carmona...
 Cordel del término de la Camorra
 Vereda de las Ventas de Sevilla o de Ronquera
 Vereda de Tocina
 Cordel de Carmona
 Cordel de Sevilla
 Vereda de la Carretera de Lora
 Colada de Brenes o de Vega Portero
 Colada de Burguillos (linking with Route 4)

Bronze Age

Route 1 (Aljarafe–Sierra Norte)

From Cobre las Cruces...
 Cordel del Conti y La Ramira
 Cañada Real de la Isla
 Vereda de Guillena a Castilblanco
 Vereda de Sevilla y Guillena
 Vereda de Guillena a Castilblanco
 Vereda de Jiguerón
 Cordel o vereda de Castilblanco al pedroso
 Cordel del Chaparral a Almadén (Follows the same path as Copper Age Route 3)

Route 2 (Alcores–Sierra Norte)

Same route as Copper Age Route 5

Route 3 (Monturque–Alcores)

From Monturque...
 Vereda del Conejo
 Vereda de Vadoancho
 Vereda de Aguilar a Santaella
 Colada del Camino de las Huertas
 Cañada Real de Don Francisco Segundo Ramal
 Cañada Real de Friillas
 Cordel de Pavia
 Cañada Real de Madre de Fuentes
 Vereda de Jarda
 Vereda del Término
 Cordel de San Juan towards Carmona (Los Alcores)

Route 4 (Guadalquivir) (Chala-Aldana 2020)

From Llanete de los Moros...
 Vereda de la Barca de Adamuz
 Vereda de Adamuz a la Barca de Montoro
 Cordel de las veredas
 Vereda del Palancar
 Cordel de Alcolea
 Cañada Real Soriana (Córdoba's Sector)
 Cordel de Peñafior
 Cordel de Posadas a Peñafior
 Cordel del Vado del Brazo
 Cañada Real Soriana (Sevilla's sector)
 Vereda de Córdoba
 Cañada Real de Mármol
 Vereda de Alcolea
 Colada de la Servidumbre de las Peñas
 Cañada Real de Córdoba a Sevilla
 Colada de Brenes o Vega Potrero
 Cordel de Brenes (towards the Guadalquivir mouth into the Lacus Ligustinus)

Route 5 (Middle Guadalquivir–Sierra Norte)

From Arva...
 Cordel de El Pedroso
 Cordel de Villanueva y Minas
 Colada de Abrevadero del Corchuelo
 Cordel de Cazalla o de la Tablilla
 Cañada Real de la Rivera del Huéznar
 Cordel de Cazalla y Extremadura
 Cordel de las Merinas
 Cañada Real de las Merinas
 Cañada Real del Pencón
 Cordel de Guadalcanal
 Vereda del Camino de la Plata o de Guadalcanal
 Cañada Real de la Candelaria y Viña del Cura
 Vereda denominada 'La Senda'
 Cañada Real Leonesa
 Cañada Real de Usagra
 Vereda de la Calzada Romana (intersects with Copper Age Route 1)

Route 6 (High Guadalquivir–Sierra Norte)

From Llanete de los Moros...
 Vereda de la Barca de Adamuz
 Vereda de Adamuz a la Barca de Montoro
 Cordel de Córdoba a Villanueva
 Cordel de Villanueva
 Cordel de Alcolea

Cañada Real Soriana
Cordel de Fuente Obejuna o de Extremadura
Cordel de Fuente Obejuna a Córdoba
Vereda de Córdoba
Colada de Peñarroya
Vereda de Granja de Torrehermosa
Cordel de Azuaga a Granja de Torrehermosa
Cordel de Valverde
Cañada real de las Bervianas
Cañada Real de Merinas (intersects with Bronze Age Route 5)

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Bibliography

- Acosta Martínez et al. 1987*: P. Acosta Martínez/R. Cabrero/R. Cruz-Auñón/V. Hurtado Pérez, Informe preliminar sobre las excavaciones de La Morita (Cantillana, Sevilla), 1985. Anuario Arqueológico de Andalucía 1985.II, 1987, 150–152.
- Asensi/Díez Garretas 1987*: A. Asensi/B. Díez Garretas, Andalucía occidental. In: M. Peinado Lorca (ed.), La vegetación de España. Colección aula abierta 3 (Alcalá de Henares 1987) 197–230.
- Amores 1982*: F. Amores, Carta Arqueológica de Los Alcores (Sevilla). Publicaciones de la Excma. Diputación Provincial de Sevilla (Sevilla 1982).
- Aubet Semmler et al. 1983*: M. E. Aubet Semmler/M. R. Serna/J. L. Escacena Carrasco/M. M. Ruiz Delgado, La Mesa de Setefilla. Lora del Río (Sevilla). Campaña de 1979. Excavaciones Arqueológicas en España 122 (Madrid 1983).
- Barragán Mallofret 2016*: D. Barragán Mallofret, La Línea de Costa Flandriense en el paleoestuario del río Guadalquivir (c. 6500 BP). Revista Atlántica-Mediterránea 18, 2016, 111–138.
- Bartelheim et al. 2021*: M. Bartelheim/D. Chala-Aldana/M. Díaz-Zorita Bonilla, The Known Unknowns. Bronze Age Settlement and Landscape Use in Southwestern Spain. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), Human-Made Environments. The Development of Landscapes as Resource Assemblages. RessourcenKulturen 15 (Tübingen 2021) 139–162.
- Blanco 1999*: J. L. Blanco, Vías pecuarias de Andalucía. Medio Ambiente 32, 1999, <https://www.junta-deandalucia.es/medioambiente/portal_web/web/servicios/centro_de_documentacion_y_biblioteca/fondo_editorial_digital/revistas_boletines/revista_ma/numeros_anteriores/ma_32.pdf> (last access 13.11.2020).

- Blanco González/Esparza Arroyo 2019*: A. Blanco González/A. Esparza Arroyo, Conectividad en la Edad del Bronce del occidente de la península ibérica. Examinando la relación entre sitios y vías pecuarias mediante SIG. *Trabajos de Prehistoria* 76, 2019, 67–83.
- Blasco Rodríguez/Ortiz Alesón 1991*: F. Blasco Rodríguez/M. Ortiz Alesón, Trabajos arqueológicos en Huerta Montero. Almendralejo (Badajoz). *Extremadura arqueológica* 2, 1991, 129–138.
- Borja Barrera/Borja Barrera 2016*: F. Borja Barrera/C. Borja Barrera, El archivo aluvial del Bajo Guadalquivir durante el Holoceno Medio-Reciente. Paleoclima, impacto humano y nivel del mar. In: A. Fernández Flores/L. García Sanjuán/M. Díaz-Zorita Bonilla (eds.), Montelirio. Un gran monumento megalítico de la Edad del Cobre. *Arqueología Monografías* 1 (Sevilla 2016) 41–66.
- Cabrero García et al. 1997*: R. Cabrero García/M. T. Ruiz Moreno/L. B. Cuadrado Martín/I. Sabaté Díaz, El Poblado Metalúrgico de Amarguillo II en Los Molares (Sevilla) y su entorno inmediato en la Campiña. Últimas analíticas realizadas. *Anuario Arqueológico de Andalucía* 1993.II, 1997, 131–141.
- Cara Barrionuevo/Rodríguez López 1987*: L. Cara Barrionuevo/J. M. Rodríguez López, Trashumancia ganadera y megalitos. El caso del Valle Medio-Bajo del río Andarax (Almería). In: *Crónica del XVIII Congreso Arqueológico Nacional (Las Palmas de Gran Canaria, Santa Cruz de Tenerife 1987) (Zaragoza 1987)* 235–248.
- Cardenete López et al. 1990*: R. Cardenete López/M. T. Gómez Saucedo/A. Jiménez Hernández/R. Lineros Romero/I. Rodríguez Rodríguez, Excavaciones arqueológicas de urgencia en el solar de la C/General Freire S/N. Sevilla. *Anuario Arqueológico de Andalucía* 1988.III, 1990, 271–278.
- Carmona Ruiz 1993*: M. A. Carmona Ruiz, La penetración de las redes de trashumancia castellana en la Sierra Norte de Sevilla. *Anuario de Estudios Medievales* 23, 1993, 111–120.
- Caro Gómez et al. 2000*: J. A. Caro Gómez/G. Álvarez García/J. Rodríguez-Vidal/J. M. Rodrigo Cámara/A. F. Buendía Moreno/S. Ayala Romero, La ocupación humana de la cueva de los Covachos (Almadén de la Plata, Sevilla). Materiales y contexto cultural. In: S. Santiago Pérez/A. Martínez García/J. Mayoral Valsera (eds.), *Actas del I Congreso Andaluz de Espeleología (Ronda 2000)* 129–135.
- Carvalho et al. 2017*: A. F. Carvalho/V. Pereira/C. Duarte/C. Tente, Neolithic Archaeology at the Penedo dos Mouros Rock-Shelter (Gouveia, Portugal) and the Issue of Primitive Transhumance Practices in the Estela Mountain Range. *Zephyrus* 79, 2017, 19–38.
- Castro Martínez et al. 1996*: P. V. Castro Martínez/V. Lull/R. Micó, Cronología de la Prehistoria Reciente de la Península Ibérica y Baleares (c. 2800–900 cal ANE). *British Archaeological Reports. International Series* 652 (Oxford 1996).
- Chala-Aldana 2020*: D. Chala-Aldana, The Full Bronze Age in the Middle and Low Guadalquivir, a Landscape of Resources (PhD-Thesis Eberhard Karls Universität Tübingen 2020).
- Chapman 1979*: R. W. Chapman, Transhumance and Megalithic Tombs in Iberia. *Antiquity* 53, 1979, 150–152.
- Conolly/Lake 2006*: J. Conolly/M. Lake, *Geographical Information Systems in Archaeology. Cambridge Manuals in Archaeology* (Cambridge 2006).
- Cruz-Auñón Briones et al. 1993*: R. Cruz-Auñón Briones/E. Moreno Alonso/P. Cáceres Misa/M. Valverde Lasantá, Informe provisional de la excavación sistemática en el yacimiento de El Negrón (Gilena, Sevilla), Campaña de 1991. *Anuario Arqueológico de Andalucía* 1991.II, 1993, 347–351.
- Davidson 1980*: I. Davidson, Transhumance, Spain and Ethnoarchaeology. *Antiquity* 54.211, 1980, 144–147.
- Delibes de Castro/Romero Carnicero 1992*: G. Delibes de Castro/F. Romero Carnicero, El último milenio a.C. en la Cuenca del Duero. Reflexiones sobre la secuencia cultural. In: M. Almagro-Gorbea/G. Ruiz Zapatero (eds.), *Paleoetnología de la Península Ibérica. Actas de la Reunión celebrada en la Facultad de Geografía e Historia de la Universidad Complutense, Madrid, 13–15 diciembre de 1989. Complutum Extra* 2/3 (Madrid 1992) 233–258.

- Domínguez Berenjano/Fernández 2008*: E. Domínguez Berenjano/A. V. Fernández, Actividad Arqueológica puntual en la Cueva del Vaquero. Anuario Arqueológico de Andalucía (Sección Sevilla), 2008, 5845–5859.
- Escacena Carrasco 1980*: J. L. Escacena Carrasco, Contribución a la carta arqueológica del Guadalquivir. Los rebordes ribereños del Aljarafe y los Alcores. Cerro del Arca, Archivo Central de la Consejería de Cultura (1980) (Sevilla 1980).
- Escudero Carrillo 2021*: J. Escudero Carrillo, A Good Place to Live? The Management of Livestock Resources in the Lower Guadalquivir Basin in the Southern Iberia During the 3rd Mill. BC. (PhD-Thesis Eberhard Karls Universität Tübingen 2021).
- Escudero Carrillo et al. 2017*: J. Escudero Carrillo/M. Díaz-Zorita Bonilla/M. Bartelheim/L. García Sanjuán, Chalcolithic Enclosures in the Lower Guadalquivir Basin. La Loma del Real Tesoro (Carmona, Seville, Spain) and Its Resources. In: M. Bartelheim/P. Bueno Ramírez/M. Kunst (eds.), Key Resources and Socio-Cultural Developments in the Iberian Chalcolithic. RessourcenKulturen 6 (Tübingen 2017) 257–272.
- Fairén Jiménez et al. 2006*: S. Fairén Jiménez/M. Cruz Berrocal/E. López-Romero González de la Aleja/S. Walid Sbeinati, Las vías pecuarias como elementos arqueológicos. In: I. Grau Mira (ed.), La Aplicación de los SIG en la Arqueología del Paisaje (Alicante 2006) 55–68.
- Fernández Caro 1991*: J. J. Fernández Caro, Excavaciones de urgencia en Las Cumbres (Carmona, Sevilla). Anuario Arqueológico de Andalucía 1987.III, 1991, 397–404.
- Fernández Gómez et al. 1976*: F. Fernández Gómez/D. Ruiz Mata/S. de Sancha Hernández, Los enterramientos en cista del cortijo de Chichina (Sanlúcar la Mayor, Sevilla). Trabajos de Prehistoria 33, 1976, 351.
- Fernández Mier/Tente 2018*: M. Fernández Mier/C. Tente, Transhumant Herding Systems in Iberia. In: E. Costello/E. Svensson (eds.), Historical Archaeologies of Transhumance Across Europe (London 2018) 219–232.
- Ferrer Albelda et al. 2005*: E. Ferrer Albelda/M. Camacho Moreno/L. de la Bandera Romero/F. J. Fernández, Informe de la prospección arqueológica superficial del Término Municipal de Peñaflor (Sevilla). Anuario Arqueológico de Andalucía 2002.III-2, 2005, 586–595.
- Galán Domingo/Ruiz-Gálvez 2001*: E. Galán Domingo/M. Ruiz-Gálvez, Rutas ganaderas, trasterminancia y caminos antiguos. El caso del Occidente Peninsular entre el Calcolítico y la Edad del Hierro. In: J. Gómez-Pantoja (ed.), Los rebaños de Gerión. Pastores y trashumancia en Iberia antigua y medieval (Madrid 2001) 279–311.
- Galán et al. 2008*: E. Galán/J. C. Fernández Caliani/I. González/P. Aparicio/A. Romero, Influence of geological setting on geochemical baselines of trace elements in soils. Application to soil of South-West Spain. Journal of Geochemical Exploration 98.3, 2008, 89–106.
- García Rivero/Escacena Carrasco 2015*: D. García Rivero/J. L. Escacena Carrasco, From the Copper Age to the Bronze Age in the Lower Guadalquivir Basin. The Cerro de San Juan settlement (Coria del Río, Seville, Spain) and the replacement model. Zephyrus 76, 2015, 15–38.
- García Sanjuán 1998*: L. García Sanjuán (ed.), La Traviesa. Ritual funerario y jerarquización social en una comunidad de la Edad del Bronce de Sierra Morena occidental. Spal. Monografías Arqueología 1 (Sevilla 1998).
- García Sanjuán et al. 2018*: L. García Sanjuán/J. M. Vargas Jiménez/L. M. Cáceres Puro/M. E. Costa Caramé/M. Díaz-Guardamino Uribe/M. Díaz-Zorita Bonilla/A. Fernández Flores/V. Hurtado Pérez/P. M. López Aldana/E. Méndez Izquierdo/A. Pajuelo Pando/J. Rodríguez Vidal/D. Wheatley/C. Bronk Ramsey/A. Delgado Huertas/E. Dunbar/A. Mora González/A. Bayliss/N. Beavan/D. Hamilton/A. Whittle, Assembling the Dead, Gathering the Living. Radiocarbon Dating and Bayesian Modelling for Copper Age Valencina de la Concepción (Seville, Spain). Journal of World Prehistory 31, 2018, 179–313.

- García Sanjuán/Wheatley 2006*: L. García Sanjuán/D. W. Wheatley, Recent Investigations of the Megalithic Landscapes of Sevilla Province, Andalusia. Dolmen de Palacio III. In: R. Joussaume/L. Laporte/C. Scarre (eds.), Origin and Development of the Megalithic Phenomenon of Western Europe. Proceedings of the International Symposium (Bougon, France, October 26th–30th 2002) (Paris 2006) 473–484.
- Garrido Fernández et al. 2015*: E. Garrido Fernández/J. C. Vera Rodríguez, Análisis espacial, contextual y funcional de un conjunto de estructuras domésticas del III milenio aC del yacimiento de ‘La Orden-Seminario’ (Huelva). *Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social* 17, 2015, 149–159.
- Guisado Castejón 2011*: F. Guisado Castejón, Prospección Arqueológica Superficial. Ámbito comarcal vinculado a la Vía de la Plata. El Hediondal 2011. Delegación Provincial de Cultura de Sevilla (archeological Report).
- Hardenberg et al. 2017*: R. Hardenberg/M. Bartelheim/J. Staecker, The ‘Resource Turn’. A Sociocultural Perspective on Resources. In: A. K. Scholz/M. Bartelheim/R. Hardenberg/J. Staecker (eds.), *ResourceCultures. Sociocultural Dynamics and the Use of Resources. Theories, Methods, Perspectives*. *RessourcenKulturen* 5 (Tübingen 2016) 13–24.
- Huntingford 1983*: E. Huntingford, La estratigrafía arqueológica de Mesa Redonda y el bajo Guadalquivir (PhD-Thesis Universidad Autonoma de Barcelona 1983).
- Hunt Ortiz et al. 2008*: M. Hunt Ortiz/J. Vázquez Paz/D. García Rivero/J. C. Pecero Espín, Dataciones radiocarbónicas de las necrópolis de la Edad de bronce, SE-K, SE-B y Jardín de Alá (Salteras y Gerena, Sevilla). In: S. Rovira Llorens/M. García-Heras/M. Gener Moret/I. Montero Ruiz (eds.), *Actas del VII Congreso Ibérico de Arqueometría* (Madrid, 8–10 de Octubre de 2007) (Madrid 2008) 226–235.
- Hurtado Pérez/Amores Carredano 1984*: V. Hurtado Pérez/F. de Amores Carredano, El tholos de Las Canteras y los enterramientos del Bronce en la necrópolis de El Gandul (Alcalá de Guadaira, Sevilla). *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 9, 1984, 147–174.
- Hurtado Pérez et al. 2000*: V. Hurtado Pérez/P. Mondéjar Fernández de Quincoces/J. C. Pecero Espín, Excavaciones en la tumba 3 de La Pijotilla. *Extremadura Arqueológica* 8, 2000, 249–266.
- Hurtado Pérez et al. 2011*: V. Hurtado Pérez/L. García Sanjuán/M. A. Hunt Ortiz, El Asentamiento de El Trastejón (Huelva). *Investigaciones en el marco de los procesos sociales y culturales de la Edad del Bronce en el suroeste de la Península Ibérica* (Sevilla 2011).
- IUSS Working Group WRB 2007*: World Reference Base for Soil Resources 2006, first update 2007. A framework for international classification, correlation and communication. *World Soil Resources Reports* 103 (Rome 2007), <https://www.fao.org/fileadmin/templates/nr/images/resources/pdf_documents/wrb2007_red.pdf> (last access 17.01.2021).
- Juárez Martín/Moreno Alonso 2010*: J. M. Juárez Martín/E. Moreno Alonso, La Molina. Una reflexión desde la caracterización arqueológica. In: J. M. Juárez Martín, *El Enterramiento en Cueva Artificial de La Molina* (Lora de Estepa, Sevilla) (Sevilla 2010) 228–234.
- Klein 1985*: J. Klein, *La Mesta. Estudio Histórico de la historia económica española 1273–1836* (Madrid 1985).
- Lara Montero et al. 2004*: D. Lara Montero/D. Barragán Mallofret/M. Garrido Martín, El asentamiento calcolítico del Parque de Miraflores (Sevilla). Resultados preliminares. *Spal. Revista de Prehistoria y Arqueología de la Universidad de Sevilla* 13, 2004, 245–255.
- Lazarich González et al. 1995*: M. Lazarich González/I. Ladrón de Guevara/M. Rodríguez de Zuolaga/M. Sánchez Andreu, El yacimiento de ‘El Acebuchal’ (Carmona, Sevilla). Un análisis de las estructuras calcolíticas a través de los escritos inéditos de J. Bonsor e historiografía. *Spal. Revista de prehistoria y arqueología de la Universidad de Sevilla* 4, 1995, 81–100.

- Llergo et al. 2007*: Y. Llergo/J. L. Ubera/J. M. Román, Análisis polínico de la intervención arqueológica de la C/ Diego Navarro 20, Carmona (Sevilla). In: M. Bendala Galán/M. B. Deamos (eds.), El nacimiento de la ciudad. La Carmona protohistórica. Actas del V Congreso de la Historia de Carmona (Carmona 2007).
- López Palomo 1993*: L. A. López Palomo, Calcolítico y Edad del Bronce al sur de Córdoba. Estratigrafía en Monturque (Córdoba 1993).
- Martín de la Cruz 1987a*: J. C. Martín de la Cruz, Memoria de los trabajos realizados en el yacimiento de Papa Uvas (Aljaraque, Huelva). Anuario Arqueológico de Andalucía 1986.II, 1987, 311–316.
- Martín de la Cruz 1987b*: J. C. Martín de la Cruz, Excavaciones Arqueológicas en España, El Llanete de los Moros. (Madrid 1987).
- Mudarra Gómez 1988*: J. L. Mudarra Gómez. Reconocimiento de los suelos de la comarca de El Aljarafe (Sevilla) (Sevilla 1988).
- Murrieta Flores 2007*: P. Murrieta Flores, Mobility, Transhumance and Prehistoric Landscape. A GIS Approach to the Archaeological Landscape of Almadén de la Plata in Andalucía, Spain (MSc-Thesis University of Southampton 2007).
- Murrieta Flores 2011*: P. Murrieta Flores, Travelling Through Past Landscapes. Analysing the Dynamics of Movement during Late Prehistory in Southern Iberia with Spatial Technologies (PhD-Thesis University of Southampton 2011).
- Murrieta Flores 2012*: P. Murrieta Flores, Understanding Human Movement Through Spatial Technologies. The Role of Natural Areas of Transit in the Late Prehistory of South-Western Iberia. Trabajos de Prehistoria 69, 2012, 103–122.
- Murrieta Flores et al. 2011a*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Antes de los mapas. Navegación y orientación terrestre en la Prehistoria Reciente Ibérica. Boletín del Instituto Andaluz del Patrimonio Histórico 19.77, 2011, 85–88.
- Murrieta Flores et al. 2011b*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Movilidad, trashumancia y paisaje prehistórico. Estudio del paisaje arqueológico de Almadén de la Plata, Andalucía a través de un SIG. In: V. Mayoral Herrera/S. Celestino Pérez (eds.), Tecnologías de información geográfica y análisis arqueológico del territorio. Actas del V Simposio Internacional de Arqueología de Mérida (Mérida 2007). Anejos del Archivo Español de Arqueología 59 (Mérida 2011) 411–423.
- Nocete Calvo 2006*: F. Nocete Calvo, The first specialised copper industry in the Iberian Peninsula. Cabezo Juré (2900–2200 BC). Antiquity 80.309, 2006, 646–657.
- Nocete Calvo 2008*: F. Nocete Calvo (ed.), El Yacimiento de La Junta de los Ríos (Sevilla 2008).
- Ojeda et al. 1990*: R. Ojeda Calvo/I. Santana Falcón/A. García Gómez, Prospección Arqueológica Superficial de los terrenos afectados por la Presa 'Jose Toran' en el Término Municipal de Puebla De Los Infantes (Sevilla). Anuario Arqueológico de Andalucía 1988.III, 1990, 345–353.
- Pellicer Catalán 2006*: M. Pellicer Catalán, Las investigaciones arqueológicas sobre la protohistoria de Carmona. Temas de estética y arte 20, 2006, 197–222.
- Pérez Macías et al. 1990*: J. A. Pérez Macías/E. Rivero Galán/R. Cruz-Auñón Briones, Estudio estratigráfico de la Cueva de la Mora (Jabugo, Huelva). Huelva en su Historia 3.2, 1990, 11–46.
- Piñon Varela 1987*: F. Piñon Varela, El Cabezo de los Vientos, La Zarcita (Santa Bárbara de Casa, Huelva). Un poblado calcolítico fortificado en el NE de la provincia de Huelva. Campaña de 1985, Anuario Arqueológico de Andalucía 1985.II, 1987, 272–278.
- Remesal Rodríguez 1990*: J. Remesal Rodríguez, Informe preliminar sobre la primera campaña de Excavaciones en Arva (Alcolea del Rio, Sevilla). Anuario Arqueológico de Andalucía 1987.II, 1990, 346–353.

- Rivas Martínez 1988*: S. Rivas Martínez, Bioclimatología, biogeografía y series de vegetación de Andalucía Occidental. *Lagascalía* 15.Extra, 1988, 91–119.
- Rojo-Guerra et al. 2014*: M. A. Rojo-Guerra/H. Arcusa Magallón/L. Peña-Chocarro/J. I. Royo Guillén/C. Tejedor Rodríguez/I. García Martínez de Lagrán/R. Garrido Pena/M. Moreno García/C. Pimenta/N. Mazzuco/J. F. Gibaja Bao/G. Pérez Jordá/I. Jiménez Jiménez/E. Iriarte/K. W. Alt, Los primeros pastores trashumanes de la Alta Ribagorza. In: I. Clemente Conte/E. Gassiot Ballbè/J. Rey Lanaspá (eds.), *Sobrarbe antes de Sobrarbe. Pinceladas de historia de los Pirineos* (Osca 2014) 127–151.
- Rojo-Guerra et al. 2020*: M. Rojo-Guerra/M. Moreno García/C. Tejedor Rodríguez/H. Arcusa Magallón/J. I. Royo Guillén/I. García Martínez de Lagrán/R. Garrido Pena/S. Díaz Navarro/L. Peña Chocarro/G. Pérez Jordá/C. Pimienta/A. Hoffman/C. Tornero/J. F. Gibaja Bao/N. Mazzucco/I. Clemente Conte, Con pastores y ovejas en la vereda de la neolitización. Una perspectiva integral de las evidencias arqueológicas de la cueva de Els Trocs (San Feliú de Veri/Bisaurri, Huesca). In: A. Carretero Pérez (ed.), *Actualidad de la Investigación arqueológica en España II (2019–2020)*. Conferencias impartidas en el Museo Arqueológico Nacional (Madrid 2020) 321–341.
- Román Rodríguez/Vázquez Paz 2005*: J. M. Román Rodríguez/J. Vázquez Paz, Intervención arqueológica de urgencia en el solar Nº 2 de la calle Calatrava de Carmona (Sevilla). *Anuario Arqueológico de Andalucía* 2002.III/2, 2005, 344–362.
- Santana Falcon 1990*: I. Santana Falcon, Excavación de Urgencia de una Estructura Siliforme de Enterramiento en el Cortijo de María Luisa (Cantillana, Sevilla). *Anuario Arqueológico de Andalucía* 1988.III, 1990, 283–285.
- Schattner et al. 2004*: T. Schattner/G. Ovejero/J. A. Pérez Macías, Prospección Arqueometalúrgica del territorio munigüense. *Anuario Arqueológico de Andalucía* 2001.II, 2004, 201–220.
- Serruto Bellido/Villamil Prieto 1990*: G. E. Serruto Bellido/J. G. Villamil Prieto, Caracterización de los suelos de la provincia de Sevilla (España). *Zona de la Campana* (Sevilla 1990).
- Sierra Alonso 1993*: F. Sierra Alonso, Excavaciones de urgencia en la Necrópolis de Canama. *Anuario Arqueológico de Andalucía* 1991.III, 1993, 467–475.
- Tsige et al. 2020*: M. Tsige/D. Gómez-Ortiz/R. Tejero/G. Garzón-Heydt, Lithostratigraphy of a Cenozoic Intra Continental Basin (Guadiana Basin, SW Spain) by Using Clay Mineral Assemblages and Geophysical Properties. *CATENA* 192, 2020, 104588.
- Valdés Castrillón et al. 1987*: B. Valdés Castrillón/M. J. Díez/I. Fernández, Atlas polínico de Andalucía occidental (Sevilla 1987).
- Walker 1983*: M. J. Walker, Laying a Mega-Myth. Dolmens and Drovers in Prehistoric Spain. *World Archaeology* 15, 1983, 37–50.
- Wheatley et al. 2010*: D. W. Wheatley/L. García Sanjuán/P. A. Murrieta Flores/J. Márquez Pérez, Approaching the Landscape Dimension of the Megalithic Phenomenon in Southern Spain. *Oxford Journal of Archaeology* 29.4, 2010, 387–405.

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Landscape Use and Transhumance in the Sierra Morena through the Ages

Keywords: *dehesas*, agriculture, pastoralism, mobility, ore mining

Abstract

In a diachronic view over large parts of the last 5000 years which focuses mainly on the Chalcolithic/Bronze Age, Roman Period, Late Middle Ages and the Modern era, Sierra Morena appears as a ResourceAssemblage in which livestock farming and the associated cattle drive, forestry and ore mining played a central role. Over time, different strategies are becoming visible with which the specific natural conditions of this mountain landscape are being countered. These are often complementary to the resources and their forms of use in the neighbouring fertile river valleys of the Guadalquivir and Guadiana. In a historical view, the ways of dealing with the respective important resources in the Sierra Morena are examined in relation to the ways of using the neighbouring landscapes. Long-term trends are also sought which characterise the specific ResourceCultures, perceptions, use and representations of the landscape in the Sierra Morena. Important aspects are the associated effects on the socio-cultural dynamics in the region.

1. Introduction

The Sierra Morena is a relatively flat mountainous landscape located between the Spanish Central Plateau (Meseta) and the Betic Depression

running west/east for approximately 300km and separating the fertile Guadalquivir valley from that of the Guadiana (*fig. 1*). Its surface is covered by open oak forests and the typical Mediterranean vegetation with poor soil quality (*fig. 2*). For long periods of human history, livestock farming has been the most sensible form of exploitation, alongside mining for the region's rich and complex ores (Domergue 1987; Pérez Macías 1996; 1998; Hunt Ortiz 2003; Bartelheim 2007; Contreras Cortés/Dueñas Molina 2010; Gauß 2015; Arboledas Martínez/Alarcón García 2018), which is not the key aspect of this paper and is thus only briefly summarised. Here the emphasis is mainly on animal husbandry, which is often linked to the mobility of livestock and people over short or long distances in order to be able to use the advantages of different ecological zones of the Sierra Morena, its neighbourhood and other parts of the Iberian Peninsula as effectively as possible under the prevailing climatic conditions. Thus, in addition to the short-distance cattle drive, which mainly connects winter and summer grazing areas in neighbouring valley and mountain regions (*trasterminancia*, transterminance), in the Iberian Peninsula the connection of distant grazing regions in the south and north has been a common form of use (*trashumancia*, transhumance), which has been well documented over long periods of history. For summer use, herds of livestock (mainly sheep, but also goats and cattle) from Andalusia were often driven to the lush grazing grounds on the edge of the northern Meseta (mainly Cordillera Cantábrica, Montes de León, Macizo Galaico, Sierra de la



Fig. 1. Topographical map of the Iberian Peninsula with the regions and geographical locations mentioned in the text.



Fig. 2. View of the Sierra Morena with a *dehesa* in the foreground, Santa Olalla del Cala.

Demanda) and for winter to the snow and ice-free regions of the south. In the course of this, they passed through the Sierra Morena on cattle drive routes that had been used repeatedly over a long period of time. These routes are still visible today and bear witness to this practice, even though in

recent decades mainly local cattle farming was practised. From a cultural-historical point of view, these livestock movements have played an important role in supra-regional communication, as significant material and immaterial exchanges took place on the routes by means of the people who were travelling with them, but also independently.

The different facets of the use of the Sierra Morena, the interlocking of the individual elements and their change over time make it clear that, in a diachronic view, this landscape represents a ResourceAssemblage, which is a constellation of heterogeneous material and immaterial resources (Hardenberg et al. 2017; Bartelheim et al. 2021a) in a constant process of change and forms the basis of various social dynamics. We have numerous information from different periods about these dynamics as well as about the individual forms of use of the landscape, although the sources differ significantly over time. The focus of the presentation here therefore varies from era to era, depending on the sources. However,



Fig. 3. View of the southern slopes of the Sierra Morena with the Guadalquivir valley, Lora del Río.



Fig. 4. View from the southern fringe of the Sierra Morena into the Guadalquivir valley with the Sierra Bética in the background, Villaverde del Río.

livestock farming, and the associated cattle drive is a constant element of the ResourceAssemblage. In accordance with the research focus of the participating authors, the paper concentrates primarily on the western part of the Sierra Morena and on studies of selected periods that comprise the Chalcolithic/Bronze Age, Roman period, Late Middle Ages and the Modern era. Even if this does not provide a closed diachronic overview, important trends can be followed over time.

A special feature of the symbiosis of livestock farming and landscape use in the south of the Iberian Peninsula is the development of the *dehesas*, whose medieval meaning as demarcated pastures for livestock changes later, as will be explained below. The term in common use today refers more to an anthropogenically shaped landscape with grazed or cultivated oak groves, which is used in many ways and thus forms the basis for various ResourceCultures. The beginnings of such a way of dealing with the landscape can be traced back to prehistory, when it formed in the course of increasing development in the context of the spread of an agro- and silvopastoral economy (fig. 3–4).

2. Pastoral Practices during the Late Iberian Prehistory in the Western Sierra Morena

Due to the special characteristics of the western Sierra Morena soils, extensive agriculture was not possible to carry out during the Copper Age and thus, along with the forest resources, the main

activity was husbandry. Some mountain areas in the Upper Guadalquivir region coped with the soil issue during the Bronze Age recurring to animal husbandry. Interaction between animals and agricultural activities via low scale manuring or stubble grazing helped to sustain economically the settlements (Chapman 2008; Knipper et al. 2020). Manuring practices have not been proven along the Lower Guadalquivir Valley yet, which is why other strategies have also to be considered, probably extensive agriculture along the *Lacus Ligustinus* and the Guadalquivir mouth and pastoralist practices throughout the Sierra Morena. Although what one can see today or what one can learn from past medieval sources might not be what happened during prehistory, one should bear in mind that this area has not been the subject of industrialisation and therefore, the landscape nowadays is not heavily modified.

It is known that during recent times populations have been self-sufficient in mountain areas during food shortages and even providing supplies to populations inhabiting the valley (Ojeda Rivera/Silva Pérez 1997). Looking back into antiquity, the management of livestock might have consisted of the typical prehistoric husbandry based on *caprines*, *suids* and *bovids*, and since modern times, they might have reflected some sort of movement within the Sierra and the fertile lands of the Guadalquivir (Joffre et al. 1988).

During the first half of the 20th cent. AD, some research on transhumance has been done on the Iberian Peninsula, mainly in Spain (Aitken 1945;

Fribourg 1910; Dantín Cereceda 1940; Fontavella 1951; Llobet/Vila 1951; Rosa 1861; Sorre 1932; Valenti 1950; Violant/Simorra 1948). From this specific and very regional point of view, research has been moved forward applying more recent methodologies and an increasingly archaeological focus (Kalkbrenner 1994; Walker 1983; Sánchez Meseguer/Galán Saulnier 2004; Logemann et al. 1994; Murrieta Flores 2012; Chapman 1979; Davidson 1980; Cara Barrionuevo/Rodríguez López 1987; Galán Domingo/Martín Bravo 1991/1992; Ruiz-Gálvez Priego 1998; Galán Domingo/Ruiz-Gálvez 2001; Murrieta Flores 2007; Wheatley et al. 2010; Murrieta Flores 2010; Carvalho et al. 2017; Fernández Mier/Tente 2018). Specifically, the object of research was to look at the relationship of prehistoric routes and mobility patterns. One of the methods for understanding the use of routes was using spatial techniques and linking megalithic monuments with potential pathways. Recent studies operating with spatial techniques have considered the connection of prehistoric monuments, prehistoric pathways, and the historical transhumance routes (Murrieta Flores et al. 2011a; 2011b; Wheatley et al. 2010). However, although results are quite positive and prehistoric monuments are associated with historical routes (Murrieta Flores 2012), it is still unclear whether those pathways could have been used during the Late Prehistory. Similar efforts are being made for studying mobility during the Bronze Age. Despite changes in funerary practices and settlement patterns, it is very likely that some natural corridors could have been used as routes for interaction between different villages along the Guadalquivir and with the Guadiana valley. Using spatial techniques such as GIS with information regarding coincidences in ceramic typology, funerary practices and types of settlement (Chala Aldana, this volume), project A 02 of the collaborative research centre (SFB 1070) RESOURCECULTURES is assessing if those corridors could have been used for moving people, ideas, objects and for herding strategies.

Another aspect to consider is the size and the configuration of the herds, which during prehistory might not have roamed the landscapes so much. The growth of the human population from the Neolithic to the Copper Age and the need to increase the size, the herds – along with the agricultural

surplus that is necessary to feed larger herds – implied the necessity of more open landscapes. This becomes even more obvious at the transition from the Copper (ca. 3200–2200 calBC) to the Bronze Age (ca. 2200–1500 calBC) when pasture and herding activities increased considerably (García Sanjuán 1999). Regarding this aspect, it is important to point out that this change during the Bronze Age is also related to a preference of settlement locations near natural corridors. Since the main activity at the Sierra Morena remains as pastoralism, the increase of herding strategies might have required seasonal mobility practices. The region's wealth in ores suggests that the deposits in the mountains were exploited, but, except for occasional in-depth investigations in peripheral areas (Pérez Macías 1996; Hunt Ortiz 2003; Arboledas Martínez et al., this volume), there is still no conclusive evidence of their prehistoric exploitation. Only in the southwestern fringe area of the Sierra Morena in Riotinto and its surroundings the intensive use in the course of the Final Bronze Age and Early Iron Age is well documented (Bartelheim 2007).

The scarcity of stable settlement architecture in southwest Spain between the Late Neolithic and the Bronze Age could be the result of a lack of visibility in the archaeological record due to the construction method or later overbuilding (Bartelheim et al. 2021b), but it also might hint to a higher degree of mobility within the area. In addition, the results of some chemical analyses on Bronze Age animal bones from the Meseta seem to support this hypothesis (Sánchez Meseguer/Galán Saulnier 2004; Logemann et al. 1994). So does the application of spatial analysis (Murrieta Flores 2012) which suggests that prehistoric habitats are more likely to be found near natural corridors. But it is not clear yet whether transhumance was the predominant strategy. On the contrary, assuming that herds were smaller than in historical times, during Late Prehistory a possible short-distance transhumance or transterminance would be more likely (Murrieta Flores 2012).

Another aspect apart from the relationship of the Sierra Morena with the Guadalquivir valley are the links with other sites in the northern part of the Sierra and the connection to the Guadiana valley. Since the megalithic sites found in the upper parts of the Sierra (Murrieta Flores 2012)

are located near natural corridors, this might have worked also both ways, towards the south (Guadalquivir valley) and towards the north (Guadiana valley, Extremadura) and the Meseta.

The use of new techniques such as biochemical analyses using strontium ($^{87}\text{Sr}/^{86}\text{Sr}$) or oxygen ($\delta^{18}\text{O}$) isotope analysis to investigate mobility in prehistoric societies has demonstrated for southwestern Spain that central places such as Valencina-Castilleja exhibit a large number of non-local human individuals (Díaz-Zorita Bonilla 2017), while some in other small places in the Sierra Morena, such as the Tholos de Palacio III, the isotope analyses of the bones showed values that point to a local provenance of the deceased (Díaz-Zorita Bonilla et al. 2009). In addition, some results from Valencina-Castilleja are showing very radiogenic $^{87}\text{Sr}/^{86}\text{Sr}$ values which are also detected in material from the Guadiana valley and are consistent with a possible interaction between both valleys. The high degree of mobility found at Valencina-Castilleja (Díaz-Zorita Bonilla 2017) is not surprising, if one considers that mega-sites with these characteristics are already engaged in long-distance trade routes (García Sanjuán et al. 2018). Specifically, while looking at mobility and dietary subsistence practices using oxygen ($\delta^{18}\text{O}$) and carbon ($\delta^{13}\text{C}$) isotope analysis (Díaz-Zorita Bonilla et al. 2017) different subsistence practices and habitats of species were detected as well as seasonal movements of cattle. Ongoing isotopic analyses are assessing whether during the Bronze Age villages in the Guadalquivir valley had close interaction with the Sierra Morena, including exchange and movement of people from the mountains to integrate with the groups living next to the Guadalquivir estuary.

Along with economic and cultural factors, climate could also have played a role in massive movements of people. Recent studies (Hinz et al. 2019) found a possible correlation between short drier phases linked to the 4.2ka BP event and demographic changes on the Iberian Peninsula. They presume a drastic reduction in settlement activity just before the transition from the Chalcolithic to the Bronze Age in southern Portugal, followed by an increase of settlement activity in southeast Spain (Hinz et al. 2019). Although the climatic development does not correlate directly with such

supposed population changes, the studies indicate that it could have played a role in the way people organised their settlement system during this period. If climate impacted the whole region in such a way, it is possible that the Guadiana and the Guadalquivir valleys could have been used for transferring people between regions during these drier phases. Some studies even consider a massive migration to the east in response to these climatic changes (Lillios et al. 2016).

Although the archaeological evidence and the scientific analyses point towards an existing connection between the Guadalquivir valley and the Sierra Morena and possibly even with the Guadiana river (see Díaz-Zorita Bonilla et al., this volume), the question of mobility is not yet solved. The link of the megalithic monuments in the Sierra Morena, with natural corridors and historical routes and the high degree of mobility at some mega sites, suggest that those natural passages in the Sierra Morena might have been used since prehistoric times. Whether there was already an organised system of transhumance, likely to have existed due to the favourable conditions of different use of resources and landscapes among the Sierra and the valley, is still under investigation. The analysis of other archaeological sites in the foothills of the Sierra Morena might shed more light on the husbandry practices and the human mobility patterns during the Bronze Age. In this way, an increase of herding activities and consequently a larger use of pasture lands at the transition from the Copper Age to the Bronze Age could be tested (see Díaz-Zorita Bonilla et al., this volume).

3. Livestock Farming and Transhumance in the Sierra Morena Area in Roman Times

While from prehistoric times we only have the hypothetical reconstruction of pathways and the analysis of animal bones, especially with regard to anatomical features and stable isotopes ($^{87}\text{Sr}/^{86}\text{Sr}$ and $\delta^{18}\text{O}$), for the reconstruction of the mobility of livestock in the Sierra Morena and its marginal zones, the spectrum of information on the conditions in Roman times is somewhat broader, but without improving fundamentally.



Fig. 5. *Dehesa* landscape in the Sierra Morena with the typical mix of holm oaks, cork oaks and pastures, Villanueva del Río.

The written sources available to a greater extent for that period report little on the subject of livestock farming and the mobility of herds, in contrast to arable farming. This applies to the Iberian Peninsula as well as to the entire Roman Empire in general (Sáez Fernández 2001). Nevertheless, it can be assumed that livestock farming played an important economic role in Roman times and built on earlier established structures, including on the Iberian Peninsula. As in prehistoric periods, the different climatic zones in the Mediterranean area and their optimal use suggested transhumant livestock farming for the Roman period. In Italy, this is documented over long distances, e.g. from southern to central Italy (Varro, ‘*Rerum rusticarum*’ II) (Gómez Pantoja 2001, 179).

In view of the natural situation on the Iberian Peninsula, which is comparable to Italy in many respects, it is reasonable to assume that the ecological potential there was also exploited in a similar way after the establishment of Roman rule, particularly in the south and east of the peninsula. However, the source situation does not allow any clear statements to be made as to the extent to which the political possibilities for more extensive transhumance already existed on the Iberian Peninsula in pre-Roman times, given the political fragmentation: was the safety of herds guaranteed? Were there agreements on grazing and transit rights? Did regional rulers force such agreements because, as owners of large herds, which formed their economic basis, they had an interest in their

ability to move between the various ecological zones? Under these circumstances, it would have been conceivable that the development of *dehesas* as grazing grounds in mountainous regions would have been promoted in order to create pastures for livestock (Aranda García 2016, 43). However, there is a lack of both historical news and archaeological evidence of this, especially from the Sierra Morena (Sánchez-Corriendo Jaén 1997). Only from the Sierra de Gredos about 250km to the north scientific studies exist that provide some insights here (López Sáez et al. 2018). There, pollen profiles from peat bogs in the period around the turn of the 21st century reveal an open landscape in the lower part of the mountain region up to 1000m above sea level, with indicators for the migration of animals (López Sáez et al. 2018, 237). Already from the Iron Age in the last millennium BC, the influence of seasonal grazing can be observed, presumably in open grazing areas, which are conceivable as *dehesas*, in the context of a cattle drift at probably short distances (transterminance) (Abel-Schaad/López-Sáez 2013). Since these altitudes correspond approximately to the highest areas of the Sierra Morena, it is evident that the use of the mountainous areas up to the upper mountain regions for cattle grazing in conjunction with an opening of the vegetation in those periods is also conceivable there (fig. 5).

A central element in ensuring the feasibility of transhumance was the guarantee of rights of way and grazing rights. With the consolidation of Roman rule on the Iberian Peninsula and the establishment of the provinces, the uniform legal conditions for the organisation of trans-regional movements of people and animals were created. According to Sáez Fernández (2001), Roman written sources report that the *mesetas* were rich in livestock that moved from there and from Extremadura through the Sierra Morena to present-day Andalusia. However, similar to pre-history, the reconstruction of paths that may have served transhumance is difficult for the Roman period. It is often assumed that pre-Roman cattle drive routes often served as generally important long-distance routes and that Roman roads were built on these routes. It is also conceivable that transhumance routes were already used by Hannibal in his battle against the Romans in Hispania

at the end of the 3rd cent. BC (Sánchez Moreno 2000). However, the actual course of Roman roads is often difficult to follow in the terrain. Although it is often known from written sources which major towns they connected, for many sections there is no concrete evidence of their exact course and they can only be accessed via favourable topographical connections. In many cases, the only remaining evidence is the conclusion of cattle drive routes that have been handed down from more recent periods.

There is very little evidence of the Roman use of the mountains for cattle drift in the Sierra Morena. Clearly related archaeological findings are not known and finds are rare. These include iron knives from the 1st cent. AD, which were found in the neighbouring Sierra de Cazorla on the upper Guadalquivir and may have been used to shear sheep in the summer months on the summer pastures there (Aranda García 2016, 53). Analyses of animal bones, which could provide information on the migration of animals, are missing, as are pollen profiles, from which anthropogenic or zoonogenic landscape changes could be deduced. Also, the evidence of ore mining in the Sierra Morena from Roman times, which is much more numerous than from prehistory, does not help much here, since it is essentially limited to the mines and the processing sites themselves (Domergue 1987; Pérez Macías 1998; Contreras Cortés/Dueñas Molina 2010; Arboledas Martínez 2010). Although it can be assumed that these production sites were integrated into a network consisting of settlements, supply systems and infrastructure as part of a ResourceComplex, there are few exceptions from the foothills where studies of the surroundings have been made (Schattner et al. 2012; Arboledas Martínez 2015).

Some epigraphic information could give an indication of animal drift. 13 funerary inscriptions from the province of Jaén that can be dated by palaeographic features and epigraphic formulation types to the period between the second half of the 1st and the middle of the 2nd cent. BC (Aranda García 2016, 61–64) were each dedicated to a deceased person by a group called *sodales*. They represent the largest concentration of inscriptions with this donor indication in the Iberian Peninsula. In one case (from Santo Tomé) they are

called *sodales oviari* (Aranda García 2016, 63). According to its common use in Hispanic epigraphy, the term *sodales* is used to refer to brotherhoods (Gómez Pantoja 2001, 184 f.). It is conceivable, in the case of the inscription from Santo Tomé, which indicates the link with sheep, that this could have been a brotherhood of shepherds who placed the inscription. Given that in more recent historical times, particularly from the Middle Ages onwards, transhumance was organised for practical logistical reasons in groups that often maintained longer-term social ties with one another, it is possible that such associations in the sense of brotherhoods already existed in Roman times. If this was the case, they could have assumed the role of family units that were otherwise responsible for burying people and affixing commemorative inscriptions, according to Aranda García (2016, 55). The remaining twelve inscriptions from the province of Jaén do not specify those *sodales*. However, Aranda García argues that the groups mentioned in the other inscriptions were also shepherds, since the majority of the ages in the texts are between 20 and 45 years. Such an adult age corresponded to the usual requirements for the activity of shepherds (Aranda García 2016, 56). Greek or Latin sounding names on the inscriptions could refer to slaves who, according to the information provided by Varro (*‘Rerum rusticarum’* II, 10), were usually used for herding cattle. In addition, ten of the inscriptions, including the one from San Tomé, are concentrated in the area at the western foot of the Sierra de Cazorla, in a relatively restricted area, which, following Aranda García, could indicate that, as in San Tomé, these could have been those of brotherhoods of shepherds (Aranda García 2016, 56).

If this assumption is correct, the distribution of these inscriptions with the *sodales* in the area at the western foot of the Sierra de Cazorla could be an indication of the existence of transhumant connections with the summer pastures in the mountainous area of the Iberian system near Cuenca, since this was accessible by a direct topographical link via the Via Augusta with the southern Meseta. Otherwise, the epigraphic and archaeological evidence in the area of the Sierra de Cazorla points to rather shorter areas of movement of livestock, in the sense of *trasterminancia*, from Cástulo and



Fig. 6. Detailed topographical map of the south of the Iberian Peninsula with the regions and sites mentioned in the text.

the eastern Sierra Morena as winter quarters to the mountainous regions of the Sierra de Cazorla, Sierra Mágina or other mountain ranges in the Jaén area as summer pastures (Aranda García 2016, 57 f.).

If the epigraphic evidence is interpreted correctly, this could be a small clue to an organisational form of the people involved in the cattle drive, which would provide information that goes beyond the prehistoric evidence. Overall, the information situation in Roman times does not offer any fundamental progress in the knowledge of the use and transformation of landscape in the context of livestock farming. For the Visigoth era and the Early Middle Ages, the archaeobotanical evidence from the Gredos mountains speaks for a continuous use of the mountain zones with varying intensities, although there, like in the Sierra Morena, the archaeological evidence for the presence of people is still very scarce (López Saéz et al. 2020, 238 f.). In the Late Middle Ages, however, especially for the phase that follows the Christian

conquest of western Andalusia in the 13th cent. AD, the abundance and explanatory quality of the sources for the use of the landscape in the Sierra Morena increases significantly. Therefore, aspects can be highlighted and details can be dealt with that have remained in the dark for earlier periods of time.

4. Livestock, Pastures and Transhumance in the Western Sierra Morena during the Late Middle Ages

The geographical area in the north of the current provinces of Huelva and Seville (*fig. 6*) forms a homogeneous territory, with a particular physiognomy that can partly explain its historical trajectory and its vocation for livestock. Indeed, it is an area dominated by a rugged relief – although not very high – which prevents the development of intensive agriculture and encourages the promotion of livestock activity (Carmona Ruiz 1994, 63).

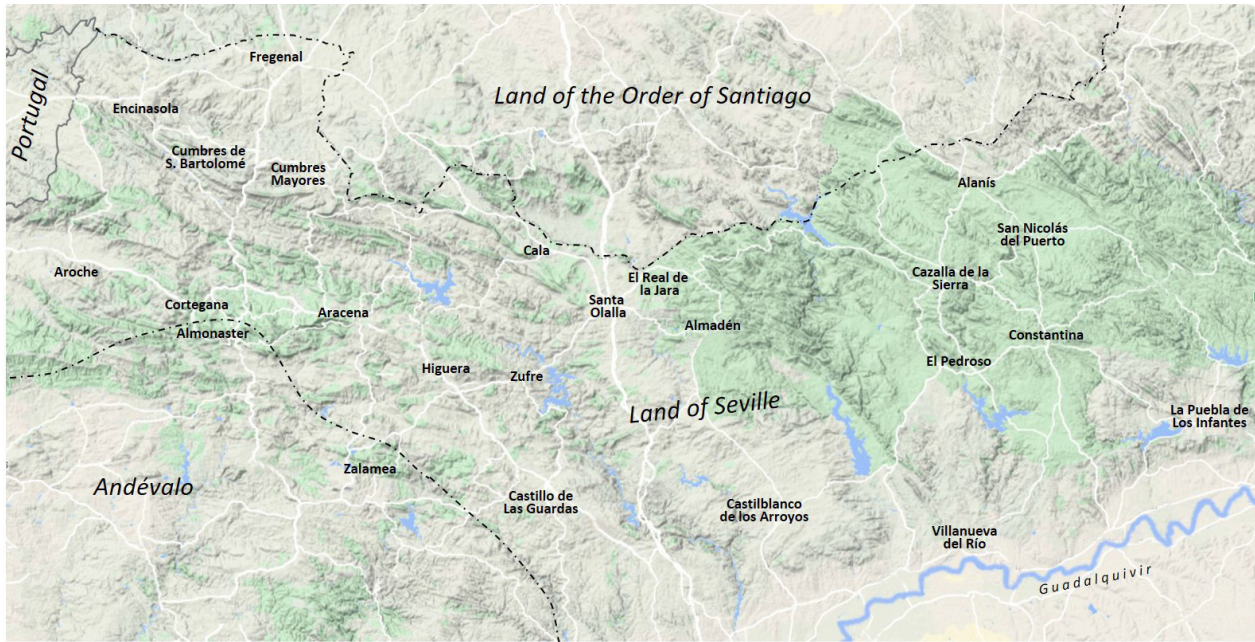


Fig. 7. Detailed map of northwestern Andalusia with Late Medieval sites mentioned in the text. The dotted line indicates the limits of the Sierra Norte (northern mountain range) of the Late Medieval Kingdom of Seville.

Thus, the Christian conquest of the territory in the 13th cent. AD meant the accentuation of the depopulation of the area, due to the flight of the scarce previous Muslim population and the preference of the new settlers for more fertile, better interconnected and safer lands, which meant that there were notable problems for its repopulation, which caused that even relatively fertile spaces were left empty and were equally susceptible to the use of livestock (Carmona Ruiz 2018, 94; this volume). The ResourceComplex surrounding medieval ore mining in the Sierra Morena has not yet received much attention. Even though written sources provide evidence of the continuous use of the deposits up to modern times, there is little material evidence of this (Martín Civantos et al. 2010). The extent to which the ResourceComplex around mining and its infrastructure overlapped with those around agriculture in the Middle Ages, in analogy to those shown by the investigations at the Roman mining municipium of Munigua, prov. Seville, on the edge of the Sierra Morena (Schattnner et al. 2012), must remain open in the absence of relevant studies.

After the conquest of the westernmost part of the Sierra Morena in the middle of the 13th cent. AD and the successive political upheavals it suffered, due to its claims by both the Portuguese and

Castilian crowns, the territory finally became part of the Kingdom of Seville, thus being included within the extensive *alfoz* (a rural territory belonging to a city) of Seville and depending on the city itself. Therefore, all the towns in this mountainous area belonged to the Land of Seville, forming part of what is known as the ‘community of town and land’. From the point of view of livestock farming, this meant that they were included in its local *mesta*, an institution that depended on the Seville council and controlled all livestock activities in Seville and its land. Furthermore, it meant the existence of a union of communal rights between all the towns subject to the control of the city of Seville, thus facilitating the mobility of the herds in search of good pastureland over a larger territory than that of the municipality to which they belonged, leaving all types of pastureland and enclosed areas outside this regime (Carmona Ruiz 1998a, 70 f.).

Within this region, a differentiation between two sectors began to emerge very early on and finally crystallised in the 15th cent. AD, with a clear internal segmentation into two regions: on the one hand, the Sierra de Constantina, closest to Seville; on the other, the Sierra de Aroche (Borrero 1998; 2000) (fig. 7). As mentioned above, due to its abrupt orography and marginal location, this entire territory was characterised during the Medieval period

by a lack of population and the existence of spontaneous vegetation from which the livestock benefited, especially during the summer months. The profusion of wild fauna also reveals that another of the economic riches of these forests was hunting. This can be seen by analysing the 'Libro de la Montería', composed as early as the 14th cent. AD, in which most of the hunting grounds described are to be found in the mountains, with the Sierra Morena and, in particular, the area of Constantina standing out (López et al. 1988, 287–289). Beekeeping development was also important in the mountain territory; although there were apiaries in all the uncultivated areas. Among the areas of special dedication to apiaries, the Sierra Morena stands out especially (Cabrera Muñoz 2003, 261). It was only in the areas closest to the Baetic Depression and with a gentler orography that human action was able to modify the forest formations, shaping a type of mountain very close to what we now call the *dehesa* landscape, that is, a space in which trees coexisted with herbaceous formations and crops of the same type. This area was dedicated especially to livestock farming, because the cattle could feed on the grass, the tree shoots and their fruits, especially the acorn (Argente del Castillo Ocaña 1990, 439).

Although after the Christian conquest of the territory the barren lands were very abundant, from early dates the municipalities began to limit certain spaces. Thus, soon emerged the *dehesas boyales* (grazing lands) destined for farm animals, to which other types of communal grazing lands were added over time, but also private grazing lands. In the case of the Sierra, in addition to the pastures for working livestock – which existed in a large number of municipalities in order to guarantee that these animals had food all year round – it is important to highlight the creation of boundaries which preserved pastureland of exceptional quality, or wood, thus preventing them from being used by livestock farmers from other towns in Seville who were subject to the regime of 'comunidad de villa y tierra' or another type of agreement. In this sense, one can highlight the conflicts that took place between Constantina and Carmona due to the attempts to prevent the entry of the cattle of Carmona's neighbours into its territory, despite the existence of a pasture brotherhood

between Seville and Carmona. Within this type of boundary, the acorn pastures were more frequent, destined mainly for local and foreign pigs. In addition, and in order to prevent the neighbours from picking up the acorns before they were ripe, the holm oak woods were fenced off when they began to mature – at the end of September – preventing people with pigs or cattle from entering the woods until the acorns were ripe and fell to the ground, opening them up for communal use at the beginning of November (Carmona Ruiz 2011). It is also worth noting that the pastures, both in the Constantina and Aracena mountains, preserved the wood from the oak groves in these places for the Seville shipyards (Carmona Ruiz 2011, 195; Pérez Embid 1999, 119).

In fact, one of the main problems that occurred in the western part of the Sierra Morena was the arrival of large numbers of cattle from other parts of Seville, taking advantage of the existence of a grazing community. The ease with which food could be found in the forests and mountains of the mountainous area meant that the problems of confrontation with farmers due to the invasion of their crops were minimal in the face of the struggles that took place between cattle breeders to provide the best food for their livestock. These confrontations increased considerably from the second half of the 15th cent. AD onwards, above all as a result of the increase in population and, therefore, in the need for more food, both for animals and people, which also led to an increase in cultivation areas to the detriment of livestock areas. For this reason, the solution sought in many mountain towns was the creation of new pastures, thus distracting large areas of grazing land from the prevailing communal regime. In order to create such pastures, the mountain councils had to obtain authorisation, either from the Crown or from the Seville Cabildo, which they did not always obtain, although they also made the restrictions illegally. In this respect we are aware of numerous lawsuits filed by cattle breeders denouncing the creation of *dehesas*. As a result, for example, in 1382 AD the Council of Seville carried out an inspection in the towns of Constantina, Cazalla, Alanís, El Pedroso and Villanueva del Camino, asking the authorities of those towns to destroy the *dehesas* that had been

illegally created (Carmona Ruiz 2011, 199). Something similar happened in the Sierra de Aroche, where at the beginning of the 16th cent. AD the council of Aroche owed a large amount of uncultivated land for communal use (Pérez-Embid 1999, 93–110). In addition, the councils of the Sierra created pastureland which they leased out and which they called *dehesas de propios*, including the Navalmentino pastureland which, in the mid-16th cent. AD, accounted for 43.7% of the total income of the council of Aracena (Pérez-Embid 1990, 200).

There were also some conflicts over the use of some *dehesas* which had originally been used by several towns and at some point one of them tried to monopolise their use. An example of this is the ruling given in 1371 AD in Seville, which forced the common use of several *dehesas* between Cortegana and Aroche (Carmona Ruiz 1994, 76). In relation to this, it is worth noting the existence of a large area between Portugal and Seville known as the ‘Tierra de la Contienda’, which was constituted as a kind of ‘no man’s land’ and was used as pasture by the councils of Aroche, Encinasola and Moura, with many conflicts due to the attempts of each of these towns to appropriate part of these lands (Carmona Ruiz 1998b).

It is therefore clear that at the end of the Middle Ages and the beginning of the Modern Age in the Sierra Norte of the Kingdom of Seville, the *dehesa* corresponds to a space which allows, above all, the grazing of the neighbouring herds, making access to the pastureland difficult for the cattle of other regions belonging to the Land of Seville, which, in spite of the severe restrictions, continued to have access to the pastureland of the area. Many of these journeys were short, in a south/north direction, and generally lasted one day. The places they went to were the areas reserved for grazing and the watering holes. Considering the large number of uncultivated areas and water points throughout the mountainous area, the possibilities of movement and the network of local roads, both temporary and permanent, had to be very complex. However, there is little information available about these short radius movements of livestock within the Seville *alfoz* itself. Thus, as was the case in modern-day Extremadura, a short-range transhumance could have taken

place throughout the mountainous region of the kingdom of Seville during the late Middle Ages and early Modern Age to make use of the mountain pastures (Clemente 2015, 564).

In any case, one can say that this availability of livestock use of the Sierra by livestock outside the local herd began to have greater difficulties from the second half of the 15th cent. AD. By then, there had already been a significant increase in the population in a large part of the Sierra Norte de Sevilla, with the consequent expansion of farming areas and the proliferation of pastures that prevented access to the pastureland. We have the specific case of the council of Fregenal de la Sierra, also included in the Land of Seville, located in a valley, experienced at the end of the Middle Ages an important agricultural development, in addition to the creation of private pastures that were leased to foreign cattle. This was so detrimental to local livestock that many of the local inhabitants were forced to leave the area in search of pasture in nearby places, sometimes going to lands belonging to the Order of Santiago in the south of the current Extremadura. Part of the beneficiaries of these leases was the transhumant livestock that, under the protection of the Mesta Real, crossed the Iberian Peninsula.

Thus, after the institutionalisation of the Council of the Mesta in the 13th cent. AD, the Crown gave legal protection to the transhumant livestock that moved from the north to the winter pastures of present-day Extremadura and Castilla-La Mancha. It could be thought that, as the conquest of Andalusia coincided with the birth of this institution, transhumant livestock would have taken over the pastures of the area. On the contrary, the important development experienced by local livestock, the protectionism deployed by the Andalusian councils and the permanent danger posed by the border of Granada may explain that, although the Crown always contemplated the possibility of using the southern pastures, during the Medieval period the *mesta* played little role in the region.

It is striking that many authors neglect the south of the peninsula when studying transhumance during the Middle Ages. In spite of this, the latest work on Andalusian livestock has shown the presence, during the final centuries of the Middle Ages, of transhumant livestock in the Upper and

Middle Guadalquivir (Argente del Castillo Ocaña 1991, 283–358). Similarly, the arrival of transhumant livestock has been noted in the northern part of the Kingdom of Seville, specifically in the council of Fregenal de la Sierra, as well as in other towns in what is now the Sierra de Huelva. Some of the transhumant livestock that arrived in the Sierra Norte of Seville after having crossed the lands of the Order of Santiago continued their journey to the Andévalo area and Portugal, taking advantage of the grazing land of the towns they passed through, and also renting out pastures where they could feed their livestock. The origin of this transhumant Mesteño livestock must have been extremely varied, although the great majority were of Soria origin. This can be seen from the fact that in the documentation of the period there are many references to *ganados sorianos* as a synonym for transhumant livestock (Carmona Ruiz 1993, 111–118). Also, in the area of Villanueva de los Infantes, reference is made to the arrival of cattle from Soria and the renting of the town's pastures in 1490 AD (Carmona Ruiz 2011, 200 f.).

Thus, it was not until the end of the 15th cent. AD that continuous information related to the activities of transhumant livestock breeders in Andalusia and specifically in the Sierra Norte of Seville was recorded. The inclusion of Andalusian lands in the Hispanic transhumance networks was favoured by the power acquired by the *mesta* during the reign of the Catholic Monarchs, the disappearance of the danger caused by the Moorish rulers, as well as by the financial problems of some councils and individuals who tried to solve these problems by leasing their lands to the transhumant pastoralists. This provoked major conflicts, not only because the local cattle breeders were seriously deprived, but also because the transhumant cattle breeders that went to some pastures damaged the crops. For this reason, the Council of Seville created some gullies for the passage of the Mesteño herds, which shows the interest of both the local towns and the Council of Seville itself in the arrival of these cattle. Nevertheless, and, as far as the Council of Seville is concerned, it benefited particularly from the lease of the El Caño pastureland, which belonged to the city's own property, with the rest of the councils of Fregenal, Bodonal and Higuera taking advantage

of the lease of the pastureland for the grazing of these transhumant livestock, and some individuals who also fenced off their land to sell the pastureland to the Mesteños (Carmona Ruiz 1993, 114).

However, in contrast to the interests of private individuals and some councils in the area, the most important livestock farmers in Seville saw their possibility of grazing in the Sierra reduced. In fact, and under the protection of the power of the municipal *mesta*, these Sevillian stockbreeders managed to get the Crown itself to recognise the obligation of transhumant livestock to pay taxes in the Sierras of Aroche and Aracena, despite the privileges of tax exemption that the Royal Mesta had throughout the kingdom (Carmona Ruiz 1998a, 382).

Therefore, already at the beginning of the Modern Age, the problem of the undue indebtedness of private lands, preventing their temporary use by cattle, was common to the whole kingdom of Seville, constituting a permanent source of conflict between farmers and ranchers. In addition, the owners of the land in question who sold their pasture used the common areas for their livestock, thereby harming the local stockbreeding industry by providing less pasture for a larger number of animals.

5. Landscape Use in the Sierra Morena in the Modern Era

5.1. The Rise and Fall of Transhumance in the Modern Era

Since the late Middle Ages, the semantic meaning and significance of both *dehesa* and transhumance have changed considerably. While well into the 20th cent. AD, the term *dehesa* retained its meaning as a pasture whose usufruct was exclusively reserved for a determined party, the growing practice of *adehesamiento*, which refers to the full privatisation of pastures by individuals and the village councils to generate income, resulted in the increasing disintegration of the *dehesas* and common rights of use. Pastures and potentially arable land, whose shared use the villagers had repeatedly fought for, were thus enclosed and in many cases leased as grazing land to the

transhumant flocks.¹ In addition, varying demographic and economic pressure from the 15th cent. AD onwards led to conversions of many (wood-) pastures into cultivated land wherever the soil allowed to do so. According to Guzmán Álvarez, the reason that the term *dehesa* is nowadays linked to the savannah-like landscape of holm and cork oaks is that this peculiar landscape constituted the *dehesas* for the local population in the sierra regions of southwestern Spain. There, the use of *dehesa* as pastures together with the notion of common rights for – at least partial – use remained because the soils of their wood-pastures did mostly not allow any alternative use (Guzmán Álvarez 2016, 10).²

The fate of the *dehesas* and the villagers whose livelihoods depended on the communal use of lands for cultivation as well as the grazing and fattening of livestock was thus still determined by the transhumant enterprise long after the Middle Ages.³ When exactly the Spanish transhumance and thus the *mesta* reached its peak, is far from agreed. While some identify this peak already in the 16th cent. AD with the indication that between 2.5 and 3 million sheep roamed the territories of the Spanish kingdom (Rodríguez Blanco 1993, 75), others date it to the second half of the 17th cent. AD when the flocks reached 3.5 million sheep (Guzmán Álvarez 2016, 7). Another interpretation designates the 18th cent. AD as the transhumance's

'highest point' (Collantes 2009, 130). If we take the sheer number of sheep as the criterion to establish the importance of transhumance, then the latter statement would be supported by the fact that in the 18th cent. AD, 4.5 million transhumant sheep are said to have roamed Spain (O'Flanagan et al. 2011, 558). Either way, transhumance, which due to its high economic importance had enjoyed protection by the very Crown, had lost its long-established privileges by the turn of the 19th cent. AD. In 1836, the *mesta*, a remnant of the glorious times of Spanish Merino wool production, was finally abolished.

Starting in the 18th cent. AD, several liberal reforms had resulted in the establishment of a market society in the Modern era which increasingly replaced the feudal order (Polanyi [1944] 2001; Collantes 2009). This meant first and foremost the acceleration of the already addressed privatisation (*adehesamiento*) and alienation of land (*desamortización*). The renewed population growth led those who held individual property rights over land to prefer to cultivate it rather than lease it as pasture for transhumant flocks in the first half of the 19th cent. AD. This new scarcity of pastures led to the increase of the rental price of winter pastures (Collantes 2009, 131). The decline in sheep raising was also due to the fact that Spain had dissolved the monopoly on the precious Merino breed, as the result of which there was actual competition from foreign states on the international wool market (Collantes 2009, 131). When in the 19th cent. AD the railway was introduced that linked southern and northern Spain, regional markets became integrated and comparative advantages in cultivation (in the lowlands, e.g. in Extremadura) and livestock farming (mountain areas in the north) were exploited. Eventually, the transport of fodder became cheaper than the transport of flocks on foot (Collantes 2009, 134).

Sheep raising in the north was increasingly based on only short-distance movement of the flocks (in Spanish referred to as *trasterminancia*) and stable feeding in winter time (Collantes 2009, 135). In addition, the increasing demand for milk and meat had given cattle breeding priority over sheep farming and in 1865 the number of transhumant sheep comprised only 1.8 million (O'Flanagan et al. 2011, 558). In the increasingly rare case that

1 The exclusion of agricultural farmers and local livestock from these private *dehesas* had the effect that the areas were no longer cleared regularly and became thus overgrown with scrub. At the end of the 16th cent. AD, the poor state of some *dehesas* was lamented by officials (Rodríguez Blanco 1993, 87).

2 After the return from his visit to the Sierra Morena region, US geographer Parsons claimed the following: '*Dehesa* is a regional term for a wooded country property; where the name persists in agricultural areas that are now treeless, it can be taken as evidence of the former presence of oak trees' (Parsons 1962, 213). The historical tracing of the term demonstrates clearly, however, that *dehesa* was a legal category of land tenure and that the sparse tree layer was 'not an essential trait of its definition' before the latter half of the 20th cent. AD (Guzmán Álvarez 2016, 5). The nominal or 'map-*dehesas*' may today be cultivated or even urbanised (Guzmán Álvarez 2016, 9).

3 Acosta Naranjo, for example, indicates the rejection of the villagers of Montemolín and Puebla del Maestre (Extremadura) when the local *dehesas* were leased to transhumant sheep at the end of the 18th and in the middle of the 19th cent. AD (Acosta Naranjo 2008, 40 f.).

the complementary use of pastures across the country was still practised, transhumance was continued. However, it was done so by other means: ‘Within very few decades, the trains almost completely replaced the only means of overland transport that had existed until then: walking, on ox roads, or on horses’ (Garzón 2017, 43, translation by M. Melles). The ancient drove way network, the *cañadas*, was adapted so that access to the train stations was guaranteed where the flocks could be loaded. These trains were in service until the late 1990s (Garzón 2017, 44). The shrinking numbers of transhumant sheep and the transport via railway left the long-distance drove ways abandoned by the flocks and shepherds.

5.2. Industrialisation and the Living Heritage of Transhumance

From the 1960s, train transport of animals was increasingly complemented by their transport on lorries (Garzón 2017, 44). In the 1980s, only 250,000 transhumant sheep were left, of which 4% were driven across the *cañadas*, 83% transferred via trains, and 13% transported on lorries (O’Flanagan et al. 2011, 558). According to Garzón (2017, 44), the last traditional long-distance transhumance across Spain dates back to the 1950s when the flocks of the Marqués de Perales were walked from La Serena (Extremadura) to the mountain passes in Lois (León) by shepherds from the Leonese village Tejerina. The further industrialisation of the production of animal feed freed farmers fully from the constraints of their local environments and led to intensification processes of livestock breeding to the detriment of extensive grazing practices (Collantes 2009, 135).

The social and economic importance of transhumance has sunk and today it somewhat oscillates between being a sheer cultural memory and an actual effort to revitalise this traditional farming practice. The results are two parallel developments: While on the one hand, transhumance is more and more turned into a heritage, it is at the same time regaining momentum as an environmentally valuable farming practice. Numerous museums and *fiestas de la trashumancia* bear witness to the transformation of transhumance into a

heritage. The museums are, however, mostly located in the north of Spain, which is the ancient origin of the transhumant flocks which were owned by wealthy stockmen. They are located in Aragón, Castile and León, in Catalonia, in La Rioja and Navarre (Vidal-González 2009, 16). In Extremadura, which provided the traditional winter pastures for the transhumant flocks, there are only two interpretation centres for transhumance and the *cañadas* in the Cáceres province.⁴

While this musealisation may be interpreted as ‘a clear indication, quite evident, of the abandonment of this activity’ (Vidal-González 2009, 16, translation by M. Melles), it may come as a surprise that the 1990s count an increased number of one million transhumant sheep, while in the period 2004–2009 there were still 800,000 (O’Flanagan et al. 2011, 570 f.). One part of the explanation for the re-awakened interest in transhumant activity dates back to initiatives of NGOs such as ‘Concejo de la Mesta’ founded in 1992 and renamed ‘Asociación Trashumancia y Naturaleza’ in 1997. The foundation of this NGO followed the 1992 UN Convention on Biological Diversity whose Article 8 (j) stipulates the maintenance of ‘practices [...] embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity’ (UN 1992). The NGO started to reintroduce annual long-distance transhumance of at least 1,000km from 1993, with ever-increasing participation of farmers and shepherds (Garzón 2017, 52 f.).⁵ For some years, a flock of a few thousand sheep, including those of other farmers, has been transported on lorries in early summer to pastures in the Cantabrian mountains. This is quite remarkable as in former times it was primarily flocks based in northern Spain that moved to the south in winter and not vice versa. The distance of 650–700km, however, is made within one day and not,

⁴ The Interpretation Centre of the High Mountains and Transhumance of Valle del Jerte <<http://vallecereza.com/valle-de-jerte/museos-y-centros-de-interpretacion-del/>> (last access 08.11.2021) and the Interpretation Centre of the Vías Pecuarias in Malpartida de Cáceres <<https://www.malpartidadecaceres.es/centro-de-informacion-y-documentacion-de-vias-pecuarias/>> (last access 08.11.2021).

⁵ Another example for the revitalisation of transhumance is the project of the Fundación Monte Mediterráneo in Santa Olalla del Cala (Andalusia).

as it used to be, during the course of weeks on foot. Since the driving of the flocks up to the pastures does not start before June 13, feast day of Saint Anthony – the patron of numerous municipalities in Castile and León – the sheep do not leave their Andalusian *dehesa* before mid-June. This poses a problem to the soils since the period between mid-May and mid-June is crucial in the regeneration of the Mediterranean ecosystems. Also, at the end of April saplings of holm and cork oaks start to grow which are eaten by the livestock that stays in the pastures (Garzón 2017, 45). The consequence are *dehesas* with disproportionately high percentages of centenary trees.⁶

In contrast to the latter project, which is above all concerned with the complementary use and regeneration of pastures in the south and north of Spain, the Asociación Trashumancia y Naturaleza highlights the importance of keeping the *cañada* system in use. They are often referred to as natural corridors as the sheep do not only fertilise the areas while making their way but also carry seeds from one place to another and thus facilitate the reproduction of plants. The *cañadas* comprise 125,000km of length and a surface of 420,000ha, which makes for 1% of the Spanish national territory. When the drove ways are not crossed by transhumant herds anymore, they become overgrown with shrubs. Other consequences are their usurpation ‘by neighbouring owners, roads, buildings, estates and landfills’ (Garzón 2017, 50, translation by M. Melles). A *cañada* system with free access and cleared roads and paths, however, is a necessary prerequisite to re-introduce transhumant activity (Garzón 2017, 51). The NGO and numerous sheep farmers and environmentalists have thus spoken out for the reclamation and preservation of the cattle roads. Their efforts were rewarded on March 23 in 1995 when the Spanish parliament passed the ‘Law of the Vías Pecuarias’ guaranteeing the *cañadas* status as public domain and their protection via the creation of the National Network of

Cattle Roads (BOE 2020). Since that day, 2,000 sheep return every year on March 23 to flock the Spanish capital and celebrate the *Fiesta de la Trashumancia* of Madrid (Garzón 2017, 53).

Apart from the revivalist and environmentalist motivation for the gradual recovery of transhumance, EU subsidies are also assessed to be a ‘main incentive’ (O’Flanagan et al. 2001, 568). The overall role of the European Union since Spain’s accession in 1986 is seen as somewhat ambiguous for sheep raising since its subsidies favour increased flocks dominated by ewes, according to whose number subsidies are calculated (Beckmann/Garzón Heydt 2009, 243). This leads to an overload of livestock in the pastures which end up overgrazed. Due to the abandonment of traditional farming practices, sheep farmers are increasingly dependent on feed from external sources and the rentability of their farms today depends heavily on the subsidies granted by the EU (Acosta Naranjo 2008, 157). On the other hand, O’Flanagan et al. (2011, 558 f.) point to the fact that EU accession has also led to small-scale recovery of transhumant practices, in particular with subsidies benefitting marginalised areas. In the central Ebro valley of Aragon, for example, the number of transhumant sheep – though, admittedly, they would rather be referred to as *trasterminantes*, meaning that they walk only short distances – increased fivefold from 25,000 to 134,000 within a decade (O’Flanagan et al. 2011, 571).

5.3. ‘There are no Shepherds Anymore – There are only *Ganaderos*’: an Extremaduran Village in the Post-Pastoral Epoch

Siruela, an Extremaduran village of not quite 2,000 inhabitants can be used to illustrate the dynamics of the post-pastoral epoch. It was declared ‘winter capital of transhumance’ in 2012 by the Asociación Trashumancia y Naturaleza and installed a monolith with this caption each at its entrances to make a visible claim for its pastoral heritage (DEX 2017) (fig. 8). Indeed, Siruela’s winter pastures played a key role in the transhumance of Merino sheep and during the 16th cent. AD, to some the peak of Spanish wool production, several meetings of the *mesta* were held there (Rodríguez Serrano 2012, 73,

⁶ Further consequences of the delayed departure of the transhumant livestock are overgrazed pastures, the pollution of water points, the destruction of shelter and food resources which are vital for the terrestrial fauna, and the disturbance of reproductive cycles of sensitive species such as bustards (Beckmann/Garzón Heydt 2009, 245).



Fig. 8. Monolith placed at the entrance to the village Siruela (Extremadura). A board provides information on the historical background to the declaration of Siruela as ‘winter capital of transhumance’.



Fig. 9. Cattle track Cañada de las Urracas (‘The magpies’ track’). This branch of the Cañada Real Segoviana crosses the Extremaduran *dehesa* landscape for almost 10km connecting the villages Tamurejo and Siruela (comarca La Siberia).

81–85). Pastoralism has always played a huge role in the village. However, memories of the elderly who are probably the last to have lived as shepherds are, needless to say, not connected to any form of long-distance transhumance across Spain, but rather to the local *dehesa*. Until today, the local usage of the term indicates that there is more to it than the simple designation of a type of landscape. Indeed, what today is, from an ecological point of view, known as *dehesa*, may also be found in other parts of the village’s surroundings. The *dehesa*, however, refers to an area of 5,000ha which,⁷ until a little over 27 years ago, belonged to the notorious Duchess of Alba (Cayetana Fitz-James Stuart, 1926–2014) and which has since then been in the hands of the village.

Indeed, Siruela is one of the many historical examples in which transhumance divided the opinions of local stakeholders, in this case the Conde of Siruela and the villagers. In 1587 an arbitration agreement was reached which granted the *siroleños* the summer pasture and the *señores* the winter pasture (Rodríguez Serrano 2012, 89). Strong tensions rose again in the 1980s when the Duchess started an effort to sell the *dehesa* of Siruela to private individuals. However, some unresolved and not further specified illegalities

revolving her forced the duchess to finally cede the *dehesa* to the Junta of Extremadura at a reasonable price. The Junta then sold the 5,000ha at a symbolic price of one peseta per hectare to the municipality – which today would equal the surreal price of EUR 30 for the entire *dehesa*.

In spite of the ambivalence marking the relation between the rent-seeking counts and their ancestors, the villagers seek to keep alive the heritage of Siruela as one of the principal showplaces of transhumance. What is more, the comarca La Siberia was declared biosphere reservation in 2019. Since 2012, the *Fiesta de la Trasterminancia* has been celebrated annually. Its core is an organised collective walk together with a flock of black Merino sheep from the village of Tamurejo to Siruela across a *cañada* of 10km length (fig. 9). Since 2017, it has been integrated into the comarca-wide *Fiesta de la Trashumancia* which enhances the festivities by two days and the route of the walk by two municipalities. In 2018, the family who organised the annual tour and breed the black merino sheep gathered a group of well-known artists such as filmmakers, authors and cartoonists and organised a three-day walk with the sheep. The *caravana negra* received much attention from the media throughout the country (fig. 10).

Asked whether they would also like to revive pastoralism, the elderly of the village, who remember their days as shepherds very well, are quite unanimous. ‘No way!’, Pablo laughs out. What was

⁷ Number repeatedly stated during an interview by the former mayor of Siruela, in November 2018.



Fig. 10. Just like in the past? A flock of black merino sheep setting off for a short-distance *trasterminancia* whose destination is the *dehesa* of Siruela.



Fig. 11. The *dehesa* of Siruela. Once roamed by shepherds and their flocks, the *dehesa* is now subdivided into smaller plots that are enclosed with wire-netting fences, cattle grids and gates.

the shepherd's life like, then? Usually, as Pablo explains, there would be three shepherds for one sheep flock, two *mayorales* (adults), and one *zagal*, as the shepherd's boy was called. Instead of going to school, Rafael, another elderly villager, would spend his entire youth as a shepherd, starting as 8 year-old and until the age of 17. The position of *zagal* meant to stay 24 hours with the flock while the *mayorales* were those held accountable for the flocks and charged with whatever else there was to organise. For instance, they went to the village for some business and brought food to the shepherds who stayed with the flock. The sheep roamed the *dehesa* which is divided into several parts referred to as *quintos*. Each *quinto* has six or seven *majadas*, spacious pens enclosed by a low drystone wall. To every such *majada* belonged a shepherd's hut, or *chozo*, where the shepherds stayed overnight. The young shepherd boys returned home only one day per month while the *mayorales* would do so on every third day, as Pablo explains.

The *zagales* were mostly the sons of the elder shepherds (Acosta Naranjo 2002, 269), and so, too, Pablo remembers how he enjoyed spending a great amount of time with his father. They would eat only twice a day and every time the same: *migas* (bread crumbs soaked in garlic water) in the morning, and milk soup in the evening. The shepherds were accompanied by mastiffs, large guard dogs with big neck folds which serve for the dog's protection in the fight with wolves or other

predators. As he felt lonely quite often as a young *zagal*, Rafael remembers how he used to talk to the dog for the lack of human company.⁸ Pablo remembers the fear he felt when the wolves came to chase the sheep, or the day when he returned to his *chozo* to discover that someone had broken in and stolen away his beloved blanket.

In the post-pastoral landscape, mobility has given way to sedentary livestock farming. While until 50 years ago, the daily walk to a water point and back to a *majada* comprised between 8km and 9km, today the *dehesa's quintos* are subdivided into smaller plots and, importantly, fenced (fig. 11). The flock stays in the plot overnight and is only from time to time moved to another. 'There are no shepherds anymore, there are only *ganaderos*', as Rafael summarises, *ganadero* referring to today's livestock farmers. 'There were no plots, there was no wire', he describes the past. Today's sheep farmers, according to Rafael, just drive their car to the plots and pour out feed from a bag, 'and that's it'. Apart from the loss of the shepherds' skills, the enclosure of the *dehesa* has also negative effects on the environment: 'Today, where there used to be a hundred sheep in one *quinto*, there are 300 or 400', another elderly villager complains,

⁸ A similar observation was made by Flores del Manzano (1993, 333).

concluding: ‘They eat more with their feet than with their mouth’.

Apart from overgrazing and the degradation of the *dehesa*’s soils, the loss of the profession of the shepherd involves the loss of the technique of *majadaleo*. From an environmental point of view, *majadaleo* is desirable due to the historical function of the sheep as welcome fertilisers (Acosta Naranjo 2002, 263). It refers to the practice of enclosing the sheep overnight in a mobile pen which is moved each day to another spot so that a certain area, the *majadal*, is intensively fertilised over a short period of time. Afterwards, this area is given time to regenerate. As a result, the best pastures of the *dehesa* were usually found in the *majadales* (Acosta Naranjo 2008, 262). Interestingly, farmers who engage in ‘holistic management’ are starting to imitate a practice which over the past decades died out. Here, the total of available pasture is subdivided into as many small plots as possible. The livestock is then moved from plot to plot every few days, leaving the soil of each plot a regeneration period of several months.

6. Conclusions

In a diachronic view of the genesis of the landscape in the Sierra Morena, especially in its western part, which is the main focus of the study here, continuities as well as discontinuities in the processes of anthropisation and use can be identified, which characterise the development of the landscape as a ResourceAssemblage. In the course of prehistory, it appears that the original forest landscape was increasingly opened up. However, archaeological evidence of this can only be found in isolated settlement and burial sites due to a lack of research activity (Pérez Macías 1997; García Sanjuán 1998; García Sanjuán/Wheatley 2006; Hurtado Pérez et al. 2011; Murrieta Flores 2012). Here, the analogy with neighbouring regions from which further relevant studies are available can help, such as in the Sierra de Gredos, where palaeoecological analyses suggest the use of altitudes corresponding to those of the upper Sierra Morena as pasture for livestock at least since the beginning of the last millennium BC (López Sáez et al. 2018). In the Sierra Morena, direct evidence

of the use of the area in the context of a Resource-Complex around agriculture with animal husbandry has not yet been found due to the lack of bone preservation possibilities. Only indirectly, isotope analyses of animal bone finds from the Guadalquivir valley speak in favour of breeding in the Sierra Morena. There are also no indications of agriculture in the Sierra Morena. The proximity of prehistoric sites to traditional drove ways and natural passages in the mountains suggests the existence of long-distance routes across the mountains, which also could have been used for cattle drives, however without any concrete evidence of this (see Díaz-Zorita Bonilla et al., this volume). The few finds of prehistoric mining activities also do not help here, nor does the more proliferous mining record from Roman times, due to a lack of investigation into the surroundings of the mines. In the Roman period there is merely indirect evidence from the eastern part of the Sierra Morena as a grazing ground in the context of small-scale livestock drift as a continuation of the Resource-Complex around agriculture, which suggests similar practices in the west, without being able to prove this with reliable source material.

For the Middle Ages we have knowledge about the increasing settlement of the Sierra Morena, especially through written documents. The formation of settlement units in the mountainous region, the associated *dehesas* and the progressive development of transhumance in the course of the establishment of the *mesta* system show an increasing structuring of the landscape. The use of this landscape has triggered certain socio-cultural dynamics. While the development of ever larger territorial units bound to lordships or belonging to settlements divided the landscape into fixed estates with local use, especially from the late Middle Ages onwards, the cattle drive over long distances became more and more important, with herds increasing in size. The now frequent crossing of the various territories with the animals and their local feeding led to conflicts over resources with regard to keeping land open for passage and the use of grazing opportunities. The ResourceCultures of the transhumant herders and the sedentary farmers were in clear opposition here, which required central regulation, as was implemented in the form of the creation of the state-controlled system

of *cañadas reales* from the 13th cent. AD onwards. However, this did not prevent the fact that until well into modern times, in the course of an increasingly large accumulation of land ownership and subsequent control by fencing, rights of passage and grazing were repeatedly called into question in many places, with corresponding disputes as consequences.

While we have only little archaeological evidence for medieval ore mining and its economic environment in the Sierra Morena, written sources report their continuous use (Martín Civantos et al. 2010). In modern times, however, mining must have suffered a massive loss of importance as a result of the discovery and subsequent exploitation of the rich deposits in the Spanish colonial areas of Latin America at the beginning of the Modern era, which probably led to a noticeable decline (Sánchez Gómez 1989, 38). Until the late 19th cent. AD, mining no longer played a significant economic role in the Sierra Morena. Only after Spain's loss of its South American colonies and the potential to mine ore on an industrial scale developed in the wake of the Industrial Revolution did mining regain a central economic function for the respective region in some marginal areas of the Sierra Morena, as with the silver and lead production in the Linares area (Dueñas Molina et al. 2010) or the copper and sulphur production in Riotinto and Tharsis (Pérez López 2006; Carvajal Quirós 2012). It retained this function until its decline due to lack of profitability in the middle of the 20th cent. AD. The metal production and its environment, including mining, reveals its character as a ResourceAssemblage, especially in the Sierra Morena, in view of the changing economic importance of the region depending on external factors such as political events (e.g. in the Spanish colonies), world market prices or technological innovations in mining technology.

During the High and Late Middle Ages, the mostly rather small-scale parcelling out of the landscape of the Sierra Morena created the basis for providing a relatively large number of people with a reasonably adequate subsistence. In modern times and especially in the last few decades, an increasingly large concentration of land in a few hands led to a clear social differentiation between, on the one hand, rich land and livestock owners

and, on the other hand, farmers, agricultural workers and herdsmen. Adequate participation in the agricultural and forestry use of the landscape as a ResourceAssemblage has been possible for increasingly fewer people in the Sierra Morena. The lack of economic development in the region and the increasing lack of prospects have encouraged massive emigration in recent decades. Particularly as a result of Spain's accession to the EU in 1986, there was a change in the regional economic structure, on the one hand towards the industrial mass production of agricultural products, and on the other towards the marketing of regional products as quality goods (e.g. Ibérico ham). In addition to a change in the forms of use of the landscape, this is also accompanied by a change in the perception of the inhabitants (as a relatively normal agricultural region instead of a social outpost), the consumers of the products (as a quality certificate instead of a backward economic region) and the visitors (as an increasingly recreational area instead of just a transit region).

The changes in the way the landscape in the Sierra Morena is treated, its perception and the socioeconomic dynamics associated with its use show in a diachronic perspective that, on the one hand, ResourceCultures typical of their time can be recognised and vary considerably from one another depending on the way they are viewed and the sources of information. On the other hand, however, there are also constants in the forms of use over all epochs (e.g. livestock farming associated with mobility) or several periods (e.g. ore mining). Social phenomena and dynamics, such as the conflicts between mobile and sedentary users of the landscape or tendencies towards differentiating the extent of land ownership in the context of economic and political processes, also shape the way the landscape is dealt with through the ages. Such an analysis with a long-term perspective of the use of the landscape requires the extension of the subject perspective to close interdisciplinary cooperation, especially with the historical sciences and cultural anthropology. This provides the opportunity to illuminate socio-cultural processes using analogies from more recent periods under comparable environmental conditions in a multi-layered way, which is not possible with purely disciplinary (e.g. archaeological) source material.

The resulting interpretative possibilities and insights help to significantly broaden the interpretive horizon in order to recognise how landscapes were (and are) organised, shaped and controlled as ResourceAssemblages and which socio-cultural and political dynamics are associated with them.

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Bibliography

- Abel-Schaad/López-Sáez 2013*: D. Abel-Schaad/J. A. López-Sáez, Vegetation Changes in Relation to Fire History and Human Activities at the Peña Negra Mire (Bejar Range, Iberian Central Mountain System, Spain) during the past 4.000 years. *Vegetation History and Archaeobotany* 22, 2013, 199–214.
- Acosta Naranjo 2002*: R. Acosta Naranjo, Los entramados de la diversidad. *Antropología social de la dehesa* (Badajoz 2002).
- Acosta Naranjo 2008*: R. Acosta Naranjo, Dehesa de la sobremodernidad. *La cadencia y el vértigo* (Badajoz 2008).
- Aitken 1945*: R. Aitken, Routes of Transhumance on the Spanish Meseta. *Geographical Journal* 106, 1945, 59–69.
- Aranda García 2016*: J. A. Aranda García, De pastores y caminos. Trashumancia en el Alto Guadalquivir en época romana. *Antiquitas* 28, 2016, 39–64.
- Arboledas Martínez 2010*: L. Arboledas Martínez, Minería y metalurgia romana en el Sur de la Península Ibérica. Sierra Morena oriental. *British Archaeological Reports. International Series 2121* (Oxford 2010).
- Arboledas Martínez 2015*: L. Arboledas Martínez, Explotación y organización de un territorio minero del sur de Hispania. *Sierra Morena oriental*. Onoba 2015.3, 79–103.
- Arboledas Martínez/Alarcón García 2018*: L. Arboledas Martínez/E. Alarcón García, Redefining the Role of Metal Production during the Bronze Age of South-Eastern Iberia. *The Mines of Eastern Sierra Morena. Documenta Praehistorica* 45, 2018, 138–153.

- Argente del Castillo Ocaña 1990*: C. Argente del Castillo Ocaña, La utilización pecuaria de los baldíos andaluces. Siglos XIII–XIV. Anuario de Estudios Medievales 20, 1990, 437–466.
- Argente del Castillo Ocaña 1991*: C. Argente del Castillo Ocaña, La ganadería medieval andaluza. Siglos XIII–XVI (reinos de Jaén y Córdoba) (Jaén 1991).
- Bartelheim 2007*: M. Bartelheim, Die Rolle der Metallurgie in vorgeschichtlichen Gesellschaften. Sozio-ökonomische und kulturhistorische Aspekte der Ressourcennutzung. Ein Vergleich zwischen Andalusien, Zypern und dem Nordalpenraum. / The Role of Metallurgy in Prehistoric Societies. Socioeconomic and Cultural Aspects of the Use of Resources. A Comparison between Andalusia, Cyprus and the North Alpine Area. Forschungen zur Archäometrie und Altertumswissenschaft 2 (Rahden/Westf. 2007).
- Bartelheim et al. 2021a*: M. Bartelheim/L. García Sanjuán/R. Hardenberg, Human-Made Environments. The Development of Landscapes as ResourceAssemblages. An Introduction. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), Human-Made Environments – The Development of Landscapes as ResourceAssemblages. RessourcenKulturen 15 (Tübingen 2021) 7–22.
- Bartelheim et al. 2021b*: M. Bartelheim/D. Chala Aldana/M. Díaz-Zorita Bonilla, The Known Unknowns. Bronze Age Settlement and Landscape Use in Southwestern Spain. In: M. Bartelheim/L. García Sanjuán/R. Hardenberg (eds.), Human-Made Environments – The Development of Landscapes as ResourceAssemblages. RessourcenKulturen 15 (Tübingen 2021) 139–162.
- Beckmann/Garzón Heydt 2009*: H. B. Beckmann/J. Garzón Heydt, Transhumance as Tool of Species Conservation in Times of Climate Change. In: D. Knaute/S. Kagan (eds.), Sustainability in Karamoja? Rethinking the Terms of Global Sustainability in a Crisis Region of Africa (Köln 2009) 235–262.
- BOE 2020*: Boletín oficial del Estado, Ley 3/1995, de 23 de marzo, de vías pecuarias, <<https://www.boe.es/eli/es/l/1995/03/23/3>> (last access 17.09.2020).
- Borrero 1998*: M. Borrero Fernández, La situación demográfica de la Sierra Norte de Sevilla a fines de la Edad Media. Siglo XV–1534, Historia. Instituciones. Documentos 25, 1998, 43–72.
- Borrero 2000*: M. Borrero Fernández, El poblamiento rural sevillano antes y después del Repartimiento, Sevilla 1248. Congreso Internacional Aniversario de la Conquista de la Ciudad de Sevilla por Fernando III, rey de Castilla y León (Madrid 2000) 319–336.
- Cabrera Muñoz 2003*: E. Cabrera Muñoz, El bosque, el monte y su aprovechamiento en la España del sur durante la Baja Edad Media. In: F. Javier Pérez-Embid (ed.), La Andalucía Medieval. Actas de las I Jornadas de Historia rural y medio ambiente (Huelva 2003) 273–292.
- Cara Barrionuevo/Rodríguez López 1987*: L. Cara Barrionuevo/J. M. Rodríguez López, Trashumancia ganadera y megalitos. El caso del Valle Medio-Bajo del río Andarax (Almería). Crónica del XVIII Congreso Arqueológico Nacional (Las Palmas de Gran Canaria, Santa Cruz de Tenerife 1987) (Zaragoza 1987) 235–248.
- Carmona Ruiz 1993*: M. A. Carmona Ruiz, La penetración de las redes de trashumancia castellana en la Sierra Norte de Sevilla. Anuario de Estudios Medievales 23, 1993, 111–120.
- Carmona Ruiz 1994*: M. A. Carmona Ruiz, Notas sobre la ganadería de la Sierra de Huelva en el siglo XV. Historia. Instituciones. Documentos 21, 1994, 63–82.
- Carmona Ruiz 1998a*: M. A. Carmona Ruiz, La ganadería en el reino de Sevilla durante la Baja Edad Media (Sevilla 1998).
- Carmona Ruiz 1998b*: M. A. Carmona Ruiz, La explotación ganadera de la frontera luso-española. La ‘Contienda’ de Moura, Nódar, Aroche y Encinasola. Revista da Faculdade de Letras. Série de História 15, 1998, 461–512.
- Carmona Ruiz 2011*: M. A. Carmona Ruiz, El aprovechamiento de los espacios incultos en la Andalucía Medieval. El caso de la Sierra Norte de Sevilla. In: E. Martín Gutiérrez (ed.), El paisaje rural en Andalucía Occidental durante los siglos bajomedievales (Cádiz 2011) 193–208.

- Carmona Ruiz 2018*: M. A. Carmona Ruiz, La transformación de los paisajes rurales en el valle del Guadalquivir tras la conquista cristiana (Siglo XIII). In: J. Torró/E. Guinot Rodríguez (eds.), Trigo y ovejas. El impacto de las conquistas en los paisajes agrarios (Siglos XI–XVI) (Valencia 2018) 93–117.
- Carvajal Quirós 2012*: J. M. Carvajal Quirós, Tharsis. Las minas de Alosno en el espacio y el tiempo (Huelva 2012).
- Carvalho et al. 2017*: A. F. Carvalho/V. Pereira/C. Duarte/C. Tente, Neolithic Archaeology at the Penedo dos Mouros Rock-Shelter (Gouveia, Portugal) and the Issue of Primitive Transhumance Practices in the Estela Mountain Range. *Zephyrus* 79, 2017, 19–38.
- Chapman 1979*: R. W. Chapman, Transhumance and Megalithic Tombs in Iberia. *Antiquity* 53, 1979, 150–152.
- Chapman 2008*: R. W. Chapman, Producing Inequalities. Regional Sequences in Later Prehistoric Southern Spain. *Journal of World Prehistory* 21, 2008, 195–260.
- Clemente 2015*: J. Clemente Ramos, La montaña extremeña (siglos XV–XVI). Paisaje y economía. *Revista de Estudios Extremeños* 71.1, 2015, 539–568.
- Collantes 2009*: F. Collantes, The Demise of European Mountain Pastoralism. Spain 1500–2000. *Nomadic Peoples* 13.2, 2009, 124–145.
- Contreras Cortés/Dueñas Molina 2010*: F. Contreras Cortés/J. Dueñas Molina (eds.), La minería y la metalurgia en el Alto Guadalquivir. Desde sus orígenes hasta nuestros días (Jaén 2010).
- Dantín Cereceda 1940*: J. Dantín Cereceda, Cañadas ganaderas españolas. *Comptes Rendus Congreso das Ciências da População* (Porto 1940).
- Davidson 1980*: J. Davidson, Transhumance, Spain and Ethnoarchaeology. *Antiquity* 54, 1980, 144–147.
- DEX 2017*: Digital Extremadura, Siruela, capital de invierno de la trashumancia, <<https://digitalextremadura.com/siruela-capital-invierno-la-transhumancia/>> (last access 18.09.2020).
- Díaz-Zorita Bonilla 2017*: M. Díaz-Zorita Bonilla, The Copper Age in South-West Spain. A Bioarchaeological Approach to Prehistoric Social Organisation. *British Archaeological Reports. International Series S2840* (Oxford 2017).
- Díaz-Zorita Bonilla et al. 2009*: M. Díaz-Zorita Bonilla/A. J. Waterman/K. J. Knudson, Explorando la movilidad y los patrones dietarios en una comunidad de la Edad del Cobre. Estudio preliminar bioarqueológico del tholos de Palacio III (Almadén de la Plata, Sevilla). In: M. Polo Cerdá/E. García-Prosper (eds.), Investigaciones Histórico-Médicas sobre Salud y Enfermedad en el Pasado. *Actas del IX Congreso Nacional de Paleopatología* (Valencia 2009) 669–676.
- Díaz-Zorita Bonilla et al. 2017*: M. Díaz-Zorita Bonilla/K. J. Knudson/J. Escudero Carrillo/H. Bocherens/L. García Sanjuán (eds), Mobility Patterns and Paleodietary Insights into Human and Cattle at the Copper Age Mega-Site of Valencina (Seville, Spain) through $\delta^{18}O$ and $\delta^{13}C$ Isotope Analysis. *Menga. Revista de Prehistoria de Andalucía* 8, 2017, 53–70.
- Domergue 1987*: C. Domergue, *Catalogue des mines et des fonderies antiques de la Péninsule Ibérique* 1 (Paris 1987).
- Dueñas Molina et al. 2010*: J. Dueñas Molina/D. Campos López/F. Molina Molina/M. Romera Martínez/A. Molina Vega/F. Villanueva Real/A. Pérez Sánchez/Á. Hidalgo Gálvez, La minería del plomo de los siglos XIX y XX. In: F. Contreras Cortés/J. Dueñas Molina (eds.), La minería y la metalurgia en el Alto Guadalquivir. Desde sus orígenes hasta nuestros días (Jaén 2010) 259–342.
- Fernández Mier/Tente 2018*: M. Fernández Mier/C. Tente, Transhumant Herding Systems in Iberia. In: E. Costello/E. Svensson, *Historical Archaeologies of Transhumance across Europe. Themes in Contemporary Archaeology* 6 (London 2018) 219–232.

- Flores del Manzano 1993*: F. Flores del Manzano, Trashumancia y pastoreo in Extremadura. Su influencia en la sociedad y cultura tradicionales. In: S. Rodríguez Becerra (ed.), Trashumancia y cultura pastoril in Extremadura (Mérida 1993) 309–339.
- Fontavella 1951*: V. F. Fontavella, La transhumancia y la evolución ganadero-lanar en la provincia de Valencia. *Estudios Geográficos* 12, 1951, 773–805.
- Fribourg 1910*: A. Fribourg, La transhumance en Espagne. *Annales de Geographie* 19.105, 1910, 231–244.
- Galán Domingo/Martín Bravo 1991/1992*: E. Galán Domingo/A. M. Martín Bravo, Megalitismo y zonas de paso en la Cuenca extremeña del Tajo. *Zephyrus* 44/45, 1991/1992, 193–205.
- Galán Domingo/Ruiz-Gálvez 2001*: E. Galán Domingo/M. Ruiz-Gálvez, Rutas ganaderas, trasterminancia y caminos antiguos. El caso del Occidente Peninsular entre el Calcolítico y la Edad del Hierro. In: J. Gómez-Pantoja (ed.), Los rebaños de Gerión. Pastores y trashumancia en Iberia antigua y medieval (Madrid 2001) 279–311.
- García Sanjuán 1998*: L. García Sanjuán (ed.), La Traviesa. Ritual funerario y jerarquización social en una comunidad de la Edad del Bronce de Sierra Morena Occidental. Spal. Monografías 1 (Sevilla 1998).
- García Sanjuán 1999*: L. García Sanjuán, Los orígenes de la estratificación social. Patrones de desigualdad en la Edad de Bronce del Suroeste de la Península Ibérica (Sierra Morena Occidental c. 1700–1100 a.n.e./2100–1300 A.N.E.). *British Archaeological Reports. International Series* 823 (Oxford 1999).
- García Sanjuán et al. 2018*: L. García Sanjuán/J. M. Vargas Jiménez/L. M. Cáceres Puro/M. E. Costa Caramé/M. Díaz-Guardamino/M. Díaz-Zorita Bonilla/A. Fernández Flores/V. Hurtado Pérez/P. López Aldana/E. Méndez Izquierdo/A. Pajuelo Pando/J. Rodríguez Vidal/D. Wheatley/C. Bronk Ramsey/A. Delgado Huertas/E. Dunbar/A. Mora González/A. Bayliss/N. Beavan/D. Hamilton/A. Whittle, Assembling the dead, gathering the living: radiocarbon dating and bayesian modelling for Copper Age Valencina de la Concepción (Seville, Spain). *Journal of World Prehistory* 31.2, 2018, 179–313.
- García Sanjuán/Wheatley 2006*: L. García Sanjuán/D. W. Wheatley, Recent Investigations of the Megalithic Landscapes of Sevilla Province, Andalusia. Dolmen de Palacio III. In: R. Jousaume/L. Laporte/C. Scarre (eds.), Origin and Development of the Megalithic Phenomenon of Western Europe. Proceedings of the International Symposium (Bougon, France, October 26th–30th 2002) (Paris 2006) 473–484.
- Garzón 2017*: J. Garzón, 25 años recuperando la trashumancia en España. *Ambienta* 120, 2017, 42–57.
- Gauß 2015*: R. Gauß, Zambujal und die Anfänge der Metallurgie in der Extremadura (Portugal). *Technologie der Kupfergewinnung, Herkunft des Metalls und soziokulturelle Bedeutung der Innovation. Iberia archaeologica* 15.1 (Tübingen 2015).
- Gómez Pantoja 2001*: J. Gómez Pantoja, Pastio agrestis. Pastoralismo en Hispania romana. In: J. Gómez Pantoja (ed.), Los rebaños de Gerión. Pastores y trashumancia en Iberia antigua y medieval (Madrid 2001) 174–194.
- Guzmán Álvarez 2016*: J. R. Guzmán Álvarez, The Image of a Tamed Landscape. *Dehesa through History in Spain. Culture & History Digital Journal* 5.1, 2016, 1–17.
- Hardenberg et al. 2017*: R. Hardenberg/M. Bartelheim/J. Staecker, The ‚Resource Turn‘. A Socio-Cultural Perspective on Resources. In: A. K. Scholz/M. Bartelheim/R. Hardenberg/J. Staecker (eds.), RESOURCECULTURES. Sociocultural Dynamics and the Use of Resources – Theories, Methods, Perspectives. *RessourcenKulturen* 5 (Tübingen 2017) 13–24.
- Hinz et al. 2019*: M. Hinz/J. Schirrmacher/J. Kneisel/C. Rinne/M. Weinelt, The Chalcolithic–Bronze Age Transition in Southern Iberia under the Influence of the 4.2 ka BP Event? A Correlation of Climatological and Demographic Proxies. *Journal of Neolithic Archaeology* 21, 2019, 1–26.
- Hunt Ortiz 2003*: M. Hunt Ortiz, Prehistoric Mining and Metallurgy in South West Iberian Peninsula. *British Archaeological Reports. International Series* 1188 (Oxford 2003).

- Hurtado Pérez et al. 2011*: V. M. Hurtado Pérez/L. García Sanjuán/M. A. Hunt/L. Ortiz, El asentamiento de El Trastejón (Huelva). Investigaciones en el marco de los procesos sociales y culturales de la Edad del Bronce en el Suroeste de la Península Ibérica (Sevilla 2011).
- Joffre et al. 1988*: R. Joffre/J. Vacher/C. de los Llanos/G. Long, The Dehesa. An Agrosilvopastoral System of the Mediterranean Region with Special Reference to the Sierra Morena Area of Spain. *Agroforestry Systems* 6, 1988, 71–96.
- Kalkbrenner 1994*: G. Kalkbrenner, Untersuchungen zur frühen Herdenviehwirtschaft auf der Iberischen Halbinsel (PhD-Thesis Universität Freiburg 1994).
- Knipper et al. 2020*: C. Knipper/C. Rihuete-Herrada/J. Voltas/P. Held/V. Lull, Reconstructing Bronze Age Diets and Farming Strategies at the Early Bronze Age sites of La Bastida and Gatas (Southeast Iberia) Using Stable Isotope Analysis. *PLoS ONE* 15.3, 2020, e0229398.
- Lillios et al. 2016*: K. T. Lillios/A. Blanco-González/B. L. Drake/J. A. López-Sáez, Mid-Late Holocene Climate, Demography, and Cultural Dynamics in Iberia. A Multi-proxy Approach. *Quaternary Science Reviews* 135, 2016, 138–153.
- Llobet/Vila 1951*: S. Llobet/V. Vila, La trashumancia en Cataluña. In: *Comptes rendus du XVI Congrès International de Géographie de Lisbonne 1949.3* (Lisbon 1951) 36–47.
- Logemann et al. 1994*: E. Logemann/G. Kalkbrenner/B. Krützfeldt/W. Schüle, Mercury in Bones of Domestic Animals. Evidence of Prehistoric Transhumance. In: V. Spiehler (ed.), *Proceedings of the 1994 Joint Tiaft/Soft International Meeting* (Tampa 1994) 163–171.
- López et al. 1988*: A. López Ontiveros/B. Valle Buenestado/R. García Verdugo, Caza y paisaje geográfico en tierras béticas según el Libro de la Montería. In: E. Cabrera Muñoz (coord.), *Andalucía entre Oriente y Occidente (1236–1492)*. Actas del V Coloquio Internacional de Historia Medieval de Andalucía (Córdoba 1988) 281–307.
- López Sáez et al. 2018*: J. A. López Sáez/A. Blanco González/D. Abel Schaad/S. Robles López/R. Luelmo Lautenschlaeger/S. Pérez Díaz/F. Alba Sánchez, Transhumance Dynamics in the Gredos Range (Central Spain) during the Last Two Millennia. Environmental and Socio-political Vectors of Change. In: E. Costello/E. Svensson (eds.), *Historical Archaeologies of Transhumance across Europe*. *Themes in Contemporary Archaeology* 6 (London 2018) 233–244.
- López Sáez et al. 2020*: J. A. López-Sáez/R. M. Carrasco/V. Turu/B. Ruiz-Zapata/M. J. Gil-García/R. Luelmo-Lautenschlaeger/S. Pérez-Díaz/F. Alba-Sánchez/D. Abel-Schaad/X. Ros/J. Pedraza, Late Glacial-Early Holocene Vegetation and Environmental Changes in the Western Iberian Central System Inferred from a Key Site. The Navamuño Record, Béjar Range (Spain). *Quaternary Science Reviews* 230, 2020, 106167.
- Martín Civantos et al. 2010*: J. M. Martín Civantos/C. Almagro Vidal/L. Arboledas Martínez, Una minería casi desconocida: épocas medieval y moderna. In: F. Contreras Cortés/J. Dueñas Molina (eds.), *La minería y la metalurgia en el Alto Guadalquivir: desde sus orígenes hasta nuestros días* (Granada 2010) 203–257.
- Murrieta Flores 2007*: P. Murrieta Flores, Mobility, Transhumance and Prehistoric Landscape. A GIS Approach to the Archaeological Landscape of Almadén de la Plata in Andalucía, Spain (MSc Thesis University of Southampton 2007).
- Murrieta Flores 2010*: P. Murrieta Flores 2010, Travelling in a Prehistoric Landscape. Exploring the Influences that Shaped Human Movement. In: J. Frischer/J. Webb Crawford/D. Koller (eds.), *Making History Interactive*. *Computer Applications and Quantitative Methods in Archaeology (CAA)*. Proceedings of the 37th International Conference (Williamsburg, Virginia, United States of America 2009). *British Archaeological Reports*. *International Series* 2079 (Oxford 2010) 258–276.

- Murrieta Flores 2012*: P. Murrieta Flores, Understanding Human Movement Through Spatial Technologies. The Role of Natural Areas of Transit in the Late Prehistory of South-Western Iberia. *Trabajos de Prehistoria* 69, 2012, 103–122.
- Murrieta Flores et al. 2011a*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Antes de los mapas. Navegación y orientación terrestre en la Prehistoria Reciente Ibérica. *Boletín del Instituto Andaluz del Patrimonio Histórico* 19.77, 2011, 85–88.
- Murrieta Flores et al. 2011b*: P. Murrieta Flores/D. Wheatley/L. García Sanjuán, Movilidad, trashumancia y paisaje prehistórico. Estudio del paisaje arqueológico de Almadén de la Plata, Andalucía a través de un SIG. In: V. Mayoral Herrera/S. Celestino Pérez (eds.), *Tecnologías de información geográfica y análisis arqueológico del territorio. Actas del V Simposio Internacional de Arqueología de Mérida (Mérida 2007)*. *Anejos del Archivo Español de Arqueología* 59 (Mérida 2011) 411–423.
- O'Flanagan et al. 2011*: P. O'Flanagan/T. Lasanta Martínez/M. Paz Errea Abad, Restoration of Sheep Transhumance in the Ebro valley, Aragon, Spain. *Geographical Review* 101.4, 2011, 556–575.
- Ojeda Rivera/Silva Pérez 1997*: J. F. Ojeda Rivera/R. Silva Pérez, Dehesas de Sierra Morena y políticas agroambientales comunitarias. *Estudios Geográficos* 58.227, 1997, 203–226.
- Parsons 1962*: J. J. Parsons, The Acorn-hog Economy of the Oak Woodlands of Southwestern Spain. *Geographical Review* 52.2, 1962, 211–235.
- Pérez-Embid 1990*: J. Pérez-Embid Wamba, Las haciendas locales en las sierras de Aroche y Aracena (Siglos XI–XVI). *Huelva en su Historia* 3, 1990, 195–212.
- Pérez-Embid 1999*: J. Pérez-Embid Wamba, Aracena y su sierra. La formación histórica de una comunidad andaluza (siglos XIII–XVIII) (Huelva 1999).
- Pérez López 2006*: J. M. Pérez López, Presencia británica en las minas de Río Tinto 1873–1954. In: A. Delgado Domínguez (ed.), *Catálogo del Museo Minero de Riotinto (Sevilla 2006)* 105–110.
- Pérez Macías 1996*: J. A. Pérez Macías, Metalurgia extractiva prerromana en Huelva (Huelva 1996).
- Pérez Macías 1997*: J. A. Pérez Macías, Anotaciones sobre el Bronce del Suroeste. Necrópolis de cistas en el entorno del Embalse de Aracena. *Huelva en su historia* 6, 1997, 67–81.
- Pérez Macías 1998*: J. A. Pérez Macías, Las minas de Huelva en la antigüedad (Huelva 1998).
- Polanyi [1944] 2001*: K. Polanyi, The Great Transformation. The Political and Economic Origins of our Time (Boston [1944] 2001).
- Rodríguez Blanco 1993*: D. Rodríguez Blanco, Ganados y señores en la Extremadura medieval. In: S. Rodríguez Becerra (ed.), *Trashumanica y cultura pastoril in Extremadura (Mérida 1993)* 69–88.
- Rodríguez Serrano 2012*: C. Rodríguez Serrano, Siruela, capital de la Mesta. In: Federación de Asociaciones Culturales de La Siberia (ed.), *La Serena y las Vegas Altas (SISEVA)*. IV Encuentros de estudios comarcales (Badajoz 2012) 55–90.
- Rosa 1861*: A. de la Rosa, Memoria de la manera de trashumancia (Madrid 1861).
- Ruiz-Gálvez Priego 1998*: M. Ruiz-Gálvez Priego, Settlement Pattern and Socio-Economic Changes in the Bronze Age/Iron Age Transition of the Spanish Meseta and Southwest. In: B. Hänsel (ed.), *Mensch und Umwelt in der Bronzezeit Europas (Kiel 1998)* 441–448.
- Sáez Fernández 2001*: P. Sáez Fernández, Los agrónomos latinos y la ganadería. In: J. Gómez Pantoja (ed.), *Los rebaños de Gerión. Pastores y trashumancia en Iberia antigua y medieval (Madrid 2001)* 159–175.
- Sánchez-Corriendo Jaén 1997*: J. Sánchez-Corriendo Jaén, ¿Bandidos lusitanos o pastores trashumantes? *Hispania Antiqua* 21, 1997, 123–154.
- Sánchez Gómez 1989*: J. Sánchez Gómez, De minería, metalúrgica y comercio de metales. La minería no férrea en el Reino de Castilla 1450–1610 (Salamanca 1989).

- Sánchez Meseguer/Galán Saulnier 2004*: J. Sánchez Meseguer/C. Galán Saulnier, El 'Cerro de La Encantada'. In: M. R. García/J. Morales (eds.), *La Península Ibérica en el II Milenio A.C. Poblados y fortificaciones* (Cuenca 2004) 115–172.
- Sánchez Moreno 2000*: E. Sánchez Moreno, Releyendo la campaña de Aníbal en el Duero (220 a.C.). La apertura de la meseta occidental a los intereses de las potencias mediterráneas. *Gerión* 18, 109–134.
- Schattner et al. 2012*: T. G. Schattner/G. Ovejero Zappino/J. A. Pérez Macías, Munigua, ciudad y territorio. In: J. Beltrán Fortes/S. Rodríguez de Guzmán Sánchez (eds.), *La arqueología romana de la provincia de Sevilla: actualidad y perspectivas* (Sevilla 2012) 207–234.
- Sorre 1932*: M. Sorre, Nomadisme agricole et transhumance dans la Sierra Nevada. *Annales de Géographie* 41, 1932, 301–305.
- UN 1992*: United Nations, Convention on Biological Diversity, <<https://www.cbd.int/doc/legal/cbd-en.pdf>> (last access 17.09.2020).
- Valenti 1950*: J. V. Valenti, Una encuesta sobre la transhumancia en Cataluña. *Pirineos* 6.17/18, 1950, 405–442.
- Vidal-González 2009*: P. Vidal-González, Los estudios y la investigación sobre etnografía pastoril. Estado de la cuestión. *Ager* 8, 2009, 9–24.
- Violant/Simorra 1948*: R. Violant/R. Simorra, Notas de etnografía pastoril pirenaica. La transhumación. *Pirineos* 4.8, 1948, 271–286.
- Walker 1983*: M. J. Walker, Laying a Mega-Myth. Dolmens and Drovers in Prehistoric Spain. *World Archaeology* 15, 1983, 37–50.
- Wheatley et al. 2010*: D. W. Wheatley/L. García Sanjuán/P. A. Murrieta Flores/J. Márquez Pérez, Approaching the Landscape Dimension of the Megalithic Phenomenon in Southern Spain. *Oxford Journal of Archaeology* 29.4, 2010, 387–405.

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Origin, Typology and Evolution of the *Dehesas* in the South of the Iberian Peninsula during the Late Middle Ages (13th to 15th Centuries AD)

Keywords: medieval livestock, *dehesas*, meadows, Andalusia, rural history

Abstract

The occupation of Hispano-Muslim territory by the Christians brought the implantation of new systems of settlement, changes in crops, alteration of livestock and forest exploitation, in short: new rural landscapes and therefore a new spatial reality. Thus, from the very moment of the Christian conquest in Andalusia, land was delimited due to different factors and with a very varied ownership. The aim of this paper is to analyse the causes of the *dehesas* and their typology according to the use to which they were to be put, studying the regional diversity conditioned mainly by geographical and socio-economic factors.

In this way, different types of pastures are to be found. The limited lands of communal use, mainly *ejidos*, meadows and *dehesas*, in which the cattle of the inhabitants could graze. There are also the so-called *dehesas de propios*, exploited for the benefit of the council. Finally, the privately owned pastures, which were used for the livestock of an individual or an institution, but which on numerous occasions were rented in order to obtain economic benefits.

Introduction

The Christian conquest of Andalusia in the 13th cent. AD caused an important transformation of the political, economic and social structures.

The change also had a profound effect on the landscape, as it meant the introduction of new systems of population, changes in agriculture, alteration of livestock and forestry operations. In short, new rural landscapes, and therefore a new spatial reality. On the other hand, the birth of a border with the kingdom of Granada led to the emergence of a space of contact between two societies at odds, the Castilian and the Nasrid, which was created in the 13th cent. AD, and remained virtually unchanged until the late 15th cent. AD. This significantly altered the logical process of implementation of the new agricultural structures and the degree of population of that space. Something similar happened on the border to the neighbouring kingdom of Portugal, which was also defined in the 13th cent. AD, and which, with a low population density, with mainly surveillance functions, developed an economy based primarily on livestock breeding.

Another reason for the notable development of livestock farming in Andalusia (*fig. 1*) is the significant demographic decline that occurred after the Castilian conquest, due to the shortage of Christian settlers and the abandonment of the region by most of the Muslim population (González Jiménez 1995). This led to a reorganisation of the settlement, with the concentration of human resources in certain villages, as well as a reduction in crops. The most obvious consequence of this was the regeneration of the natural ecosystems with the consequent development of forests and woodlands most notably in the wide mountain areas that bordered the Andalusian Depression. The resources were used for an important development of activities such as hunting, fishing, beekeeping,

forestry and livestock. From all of them, we must emphasise the importance of the livestock breeding, which had a remarkable advance, not only due to the existence of abundant natural resources, but also for the impulse and protection provided by the authorities. Therefore, although there are territories where livestock breeding was predominant, especially in the sierras and border territories, the reality is that with a greater or lesser intensity, livestock breeding experienced a significant boost throughout Andalusia (Argente del Castillo Ocaña 1991; Carmona Ruiz 1998).

The Origin of the *Dehesa* in Medieval Andalusia

Due to the necessary balance between agriculture, stockbreeding and the exploitation of uncultivated spaces, after the conquest of al-Andalus, there was an organisation of the agricultural space around the centres of the population. At the beginning, the change was not very significant, since the form of organisation developed by the Castilians in Andalusia was very similar to that previously used by the Islamic villages. In fact, in the *alquería* the territory was divided between unsuitable land or *mubāḥa* and suitable land or *mamlūka*. The former was in turn subdivided into *ḥarīm* (communal space) and *mawāt* (dead land) subject to appropriation (Linant de Bellefonds 1959, 111 f.). This system was easily comparable to the Castilian tradition, where in addition to privately owned land, there were areas for communal use (Carmona Ruiz 1998, 121 f.).

Thus, after the Christian conquest of the 13th cent. AD, uncultivated spaces were preserved for communal use, which were mainly used for feeding livestock, although they were also susceptible to other uses, such as the collection of firewood and wood, wild fruits, charcoal, lime and plaster manufacture, beekeeping, hunting and fishing. All of these could serve as a complement to the always precarious peasant economies. Therefore, there are several types of lands and communal rights:

On the one hand, the open lands of common use, also known as *tierras realengas*. These were communal lands or wastelands. Although legally there could be a difference between communal

lands and wastelands, the first ones constitute the land extensions reserved during the repopulation process or later for the common use of the inhabitants, while the wastelands are uncultivated spaces that haven't been distributed at first but were susceptible of being so in the future. In fact, the wastelands are integrated within the goods of communal use and at the end of the Middle Age, there is no clear distinction between one or another type of lands (Vassberg 1986, 35).

Likewise, there were the enclosed lands for communal use, the *dehesas*, which arose due to the need to reserve grazing areas for livestock. In addition, the councils, in order to alleviate their economic needs, would use a number of meadows as their own property and there were some community rights over private properties, as in the case of *la derrota de mieses*. This was a practice whereby cattle were allowed to enter farmland after the harvest had been gathered, feeding on any leftovers. In this way, the cattle could be fed in summer with better grass than those in the forests, fertilising the land at the same time.

Therefore, after the Christian conquest, and following the general trend of the traditional Castilian system of agricultural organisation, the terrace was structured into several areas of use arranged in circles around the population centres that can be separated into:

- *Los ruedos*. A ring located near the population centres with intensive crop farming, among which the orchards and fodder plant crops stand out.
- A second, wider circle were the core components of the agricultural system to be found: land used for cereals, olive groves and vineyards. Also, in this space were the grasslands, the *dehesas*, and uncultivated lands where animals, especially small livestock, could graze.
- And finally mountains or wastelands, normally the areas furthest from the population centre, although they were included into land-use, dedicated mainly to grazing or foresting.

Among all these spaces, those studied are the enclosed spaces, the *dehesas*, generally located within the core component of the agricultural system. First the changes in the meaning of *dehesa* have to be discussed.

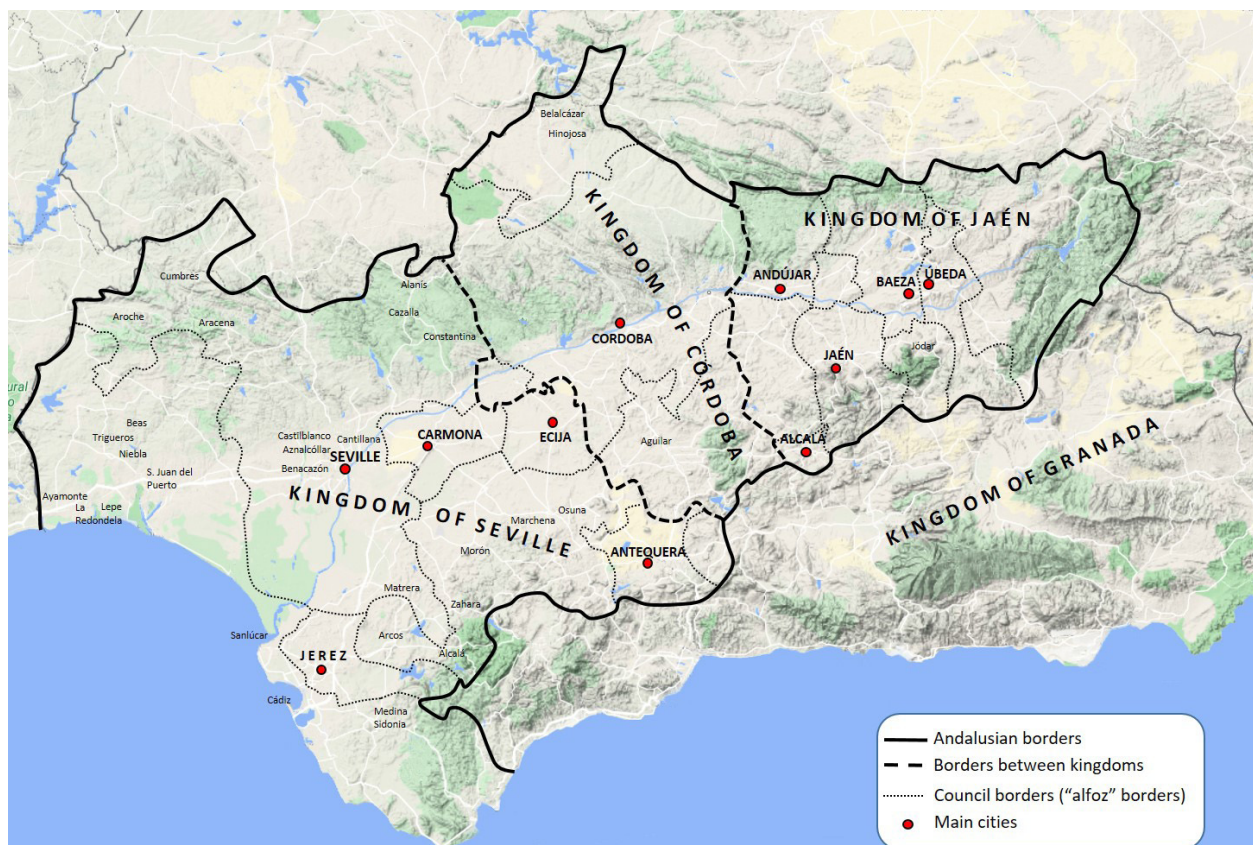


Fig. 1. Map of Andalusia with regions and sites mentioned in the text.

Nowadays *dehesa* is understood as a type of landscape or agricultural exploitation area. Generally, this designation covers a type of landscape of pastures and hollow oak forests, extensively used for grazing and on which certain silvicultural and hunting practices can be found. It is only in very recent times (second half of the 19th cent. AD at the earliest) that the word *dehesa* acquires the meaning of a sparsely wooded formation with which we identify it today.

Throughout history the term *dehesa* has been used to designate various types of enclosed pastureland, without specific direct reference to the plant formations that covered it, so that different proportions of pastureland, trees and scrubland were found there.

Etymologically, the word *dehesa*, *defessa* in medieval times, meant ‘defense’ and *defessar* meant to subtract a certain portion of land from common pasture, reserving its use for a certain type of livestock or for livestock belonging to specific owners. It is supposed that this type of distinction already existed in Roman times (Aranda García 2016, 41)

and that it was also maintained in Islamic times. In fact, it can be considered that the emergence of *dehesas* is mainly linked to the agricultural development and the need for beasts of burden, mainly oxen and equids, hence this was the most widespread type of *dehesa* in medieval municipalities.

Typology of *Dehesas* in Medieval Andalusia

At the beginning all the uncultivated spaces of the medieval councils that were of communal use could be used by all the inhabitants of a town without any kind of restrictions. However, economic needs and political circumstances gradually led to the emergence of use restrictions and different types of boundaries. Similarly, some landowners created privately owned pastures.

The need to guarantee grazing for farm animals explains the emergence of *dehesas* for oxen, a particularly problematic issue in intensively cultivated areas. This matter was attempted to be remedied in cereal farming land by allowing

animals to graze after harvest. However, this was not enough, and it was also necessary to provide enclosed pasture for farm animals in times when they could not be kept on the fields. The fact that this type of *dehesas* appeared in most Andalusian villages after the conquest may be an indication of its widespread presence in earlier times.

Consequently, from the very moment of the Christian conquest, in most Andalusian towns at least one pastureland intended to guarantee the grazing of farm oxen belonging to the local residents is to be found. These *dehesas* were usually called *dehesas concejiles* or *dehesas boyales*.

Occasionally, some communal grazing lands were also created for other types of livestock. There were also *dehesas* that were intended only to preserve the best pastures in an area for the exclusive use of the livestock belonging to the residents of a town or village and to avoid their use by livestock from localities with which they had made some kind of brotherhood agreement.

The characteristics of the *dehesas boyales* varied from one place to another, depending mainly on the geographical location and the extent of the municipal area in which it was located. Its vegetation, surface and location varied with respect to cultivated areas and population centres. Sometimes it could be very large, more than it was necessary for the local livestock, especially so from the 15th cent. AD, when as a result of demographic and economic expansion that occurred, its areas were reduced in favour of crops. In other cases, such as in the Aljarafe area, these pastures were insufficient, especially at the time of agricultural expansion, therefore they were sometimes expanded or new ones were created (Borrero Fernández 1992). Sometimes the problems of space in some *dehesas* were resolved by prohibiting their use by people who had private *dehesas*, so that the municipal *dehesas* were used for the livestock of inhabitants who did not have large enough properties to have their own *dehesas*. On the other hand, all regulations coincide in strictly prohibiting the entry of small livestock and specifically pigs, because of the damage they caused to the ground with the rooting and fouling of the water.

Municipal *dehesas* usually were situated close to the settlement, for the ease of access and guarding the animals, but not on the most fertile soils.

However, sometimes the quality of pastures or the extent of cultivated land made it necessary for them to be established in marginal areas far from the population centre. This is the case at Aljarafe (Borrero Fernández 1992). There are some *dehesas* shared by several villages, possibly due to the fact that at the time of the establishment of *dehesa*, the borders of these villages were not well defined. This is the situation of the one shared between Cumbres Mayores and Cumbres de San Bartolomé. Sometimes it could be the result of some kind of agreement between the localities. This is the case of the Dehesa del Campillo, shared by the residents of Ayamonte, Lepe and La Redondela, or the Dehesa de Alcolea, which was used by the residents of Niebla, Trigueros, Veas and San Juan del Puerto (Carmona Ruiz 1998, 124 f.), or the *dehesa* of La Encinilla, which was used jointly by Hinojosa and Belalcázar (Cabrera Muñoz 1977, 251).

In order to renew their pastures, the *dehesas* were left to rest during the period when the cattle could feed on the arable land, either by grazing on the cereal stubble or the fodder that the owners could provide. Sometimes during part of this time, the *dehesas* were used by different animals, as in the case of Benacazón, where, after the oxen left at the end of September, cows and mares occupied it until mid-January, with the pasture resting until May (Carmona Ruiz 1998, 128).

In addition to oxen and cows, the local bulls might have been given access to the *dehesas boyales*. Sometimes, due to the danger in which they put other cattle, sections called 'bullfighters' or 'bulls' were built, as in the case of the Dehesa de Almanzor, Utrera, but in other cases complete *dehesas* were reserved for bulls, as at Jerez, where there were two *dehesas*: the Berlanga and the Jardilla. Sometimes, horses could also access the *dehesas boyales*, as in the case of Carmona or Cantillana (Carmona Ruiz 1998, 129 f.). However, the usefulness of these animals made it advisable to create *dehesas* reserved exclusively for them. This type of *dehesas* was of special interest in frontier lands since, due to the needs of war, special care was taken with their breeding and feeding. Furthermore, the work of threshing with the mares and their importance for reproduction explains why they also appear in cereal-producing areas (Carmona Ruiz 1998, 130; 2006, 262 f.).

In some localities, in order to guarantee the supply of meat, *dehesas* for livestock to be slaughtered were created. These arose belatedly, from the second half of the 15th cent. AD, in response to complaints from some butchers about the lack of space to feed the cattle that went to the butchers. An example of this is the Dehesa de Tablada, which was set up by the Seville Council for the cattle that supplied the city's butchers (Carmona Ruiz 1998, 131 f.). Although usually only cattle destined for public butchers' shops entered the *dehesas*, in the case of Jerez de la Frontera it also took in the milk cows of the city's poor and it was also permitted to take grass for the horses (Carmona Ruiz 2014, 199).

In addition, because of the quality of their pastures, some *dehesas* were reserved for the exclusive use of local cattle, not allowing the cattle of other localities. Within this category would be some *dehesas*, such as the Islas y Marismas del Guadalquivir, which were for the exclusive use of the residents of the city of Seville, and numerous acorn *dehesas* located mainly in the mountainous regions. There, the best holm oaks were reserved exclusively for the inhabitants of the different localities, prohibiting the entry of cattle from other villages with which there was a brotherhood agreement or which belonged to the same *alfoz* (i.e. rural environment). Thus, there is proof of the enclosure of numerous holm oak groves both in the Sierra de Aroche and Aracena, and in the Sierra de Constantina (Carmona Ruiz 1998; 2011b). In the same way, some *dehesas* were created in which only the neighbours of a town could use the wood of their trees, as in the case of Cortegana (Pérez-Embid 1999, 99).

A particular type of pasture were the so-called *echos*. These were quite frequent in the Cadiz area, especially known in Jerez de la Frontera (Martín Gutiérrez 2015), although they also appear in other councils of the Kingdom of Seville, as is the case of Matrera, Carmona, Ecija or the county of Niebla. They were usually used for cattle, and it is likely that the origin of the word was the lottery with which these lands were distributed. In the case of Jerez, the *echos* were reserved for the use of the cattle of the residents of that city and were assigned to the different farmers by means of a draw for their use for three years. Only those owners who had at least 150 cows could participate

in the draw, which was the minimum allowed to maintain an *echo*, where no more than 300 cows could enter either. If an owner had enough cows to occupy more than one *echo*, he could enter the draw for two, but never for more. This regulation, which is known from the end of the 15th cent. AD, clearly benefited the owners of large herds, who mainly belonged to the citizen oligarchy, which controlled all the council activity and therefore regulated the system of providing pasture to the local cattle. In contrast to these privileged few, the rest of the inhabitants, owners of less than 150 heads of cattle, which should be the vast majority, had to solve the problems of maintenance of their livestock as well as they could (Carmona Ruiz 1996).

In some localities, there were also seasonal restrictions on certain communal spaces, seeking an equitable distribution of their assets. The case of the holm oak woods can be highlighted. In Carmona access to the woods was restricted by the end of September each year, preventing the entrance of people with sticks or cattle in the mountains, until the acorn was mature and fell to the ground, re-opening for communal use on November 1st. By this, it was tried to prevent people from picking the acorns before they were ripe (Carmona Ruiz 2011a).

Finally, within the limited spaces of communal use, we can talk about the *ejidos*, which were the lands that surrounded the population centres. They were areas of expansion of the villas, where new houses could be built. Meanwhile, they were destined to the development of some collective activities of the inhabitants, among which were the feeding of some types of livestock, mainly donkeys and horses (Carmona Ruiz 1998, 115–118).

Besides the communal regime, there were also other types of *dehesas*. Firstly, the so-called *dehesas de propios*. The council owned these and leased them out for the use of any type of livestock. These *dehesas* allowed the council to cover its expenses and therefore benefited the town. Because of that, this type of enclosure proliferated throughout Andalusia. They could originate in royal donations, in the case of Matrera (now Villamartín), granted to the council of Seville by Alfonso XI (1311–1350 AD), but usually they were purchased or repurposed communal grounds.

On some occasions, the purpose of the benefits obtained from renting them is specified, as is the case of the Dehesa de los Cuellos de Baeza, which was granted by Alfonso XI for the maintenance of the city walls (Argente del Castillo Ocaña 1991, 533). Amongst the *dehesas de propios* that existed in Andalusia, those created in Constantine and Aracena should be mentioned, reserving the best oak woods for the Seville shipyards (Carmona Ruiz 2011b, 105; Pérez-Embid 1999, 119).

At certain times some of the *propios* farmland was no longer rented out in order to allow the entry of livestock that was withdrawn from the border to the kingdom of Granada in times of danger (Argente del Castillo Ocaña 1988; 1998; Carmona Ruiz 2009). This is the situation of the Dehesa de la Torre don Ibáñez, in Baeza (Carmona Ruiz 2012), or that of Matrera (Carmona Ruiz 1998, 143–147), which also shows the economic value that livestock farming had in late medieval Andalusia.

The proliferation of privately owned *dehesas* must also be mentioned. These generally belonged to institutions or individuals, who enjoyed all profits. Among these *dehesas* we can highlight those that were made on crop lands destined for plough oxen, although there were numerous *dehesas* or rented out for other people's livestock of different kind. *Dehesas* for farm animals on grain lands were carried out with royal or local authorisation. These types of pastures were also known as *dehesas dehesadas*, and their size varied according to the quality of the land and the possibilities of the area. Similarly, private *dehesas* for the use of other types of livestock came from royal donations, although sometimes they were obtained through purchase, or by bartering with other lands (Carmona Ruiz 1998, 155 f.).

Some gentry were in possession of large mountain areas for their exclusive use, mainly hunting. For example in La Puebla de Cazalla the Earls of Ureña had exclusive access to the forest of Hontanar and the forest of Cote near Morón. In Marchena, the Duke of Arcos owned the Monte Palacio, renting it out for cork production (Carmona Ruiz 1998, 159). In the kingdom of Jaén, there is the case of the benefits that Alonso de Carvajal, Lord of Jódar, obtained from renting his meadows, or in the kingdom of Córdoba, those that the Lord of Aguilar or the Lord of Belalcázar

obtained from their meadows (Argente del Castillo Ocaña 1991, 554–558).

Finally, there are the lands that the Andalusian livestock farmers leased in the kingdom of Granada, linked to the movement of livestock on both sides of the border. There are documents relating to the renting of pastures to graze cattle coming mainly from Zahara, Jerez, Arcos, Alcalá de los Gazules and Medina Sidonia in Cortes and from Gibraltar in Casares. Similarly, the Grenadians leased pastures in Andalusia, as is the case of the lease of the *echo* of the Genal, made by residents of Gibraltar to the Moors of Casares around 1471 AD (Carmona Ruiz 2009).

The Evolution of the Andalusian *Dehesas* at the End of the Middle Ages

As was already indicated, the conquest of Andalusia meant a significant increase in livestock breeding. This situation continued into the 14th cent. AD due to various factors that prevented a demographic growth of Andalusia, such as the border war, the various cycles of epidemics and the poor harvests that affected the region throughout the century (Collantes de Terán 1982). The scenario began to change at the beginning of the 15th cent. AD, when a progressive population growth was detected, with the consequent increase in cultivated areas and the appearance of new populations. Thus, the 15th cent. AD brought about an important change in the economy of the area due to pushing back of the borders of Granada (the conquest of Antequera in 1410 AD and Ronda in 1485 AD are particularly noteworthy), and the definitive conquest of the Nasrid kingdom in 1492 AD. In fact, after the conquest of Granada, instability and fear were dissipated. The main consequence was a significant population growth stimulated by the agricultural potential of much of the border area, the Campiña. This region became a major attraction for new settlers, with the consequent ploughing and the creation of new settlements, such as Villamartín (in the Dehesa de Matrera), Paradas, Campillos, Puebla de Cazalla and so on (Collantes de Terán 1977).

The subsequent clearing of land caused by this growth had a significant negative impact on

Andalusian livestock farming, due to the significant reduction in the amount of land used for grazing. This produced considerable imbalances in the development of economic activities and quite a lot of damage to livestock, because many communal pastures disappeared. This agricultural development meant a greater need for working livestock, so the main consequence of this development was the proliferation of both public and private *dehesas*, mainly for working livestock, which was essential for the proper development of agricultural activities. The *dehesas boyales* that existed in previous times were not always sufficient to maintain all the working livestock, so it was necessary to expand them by purchasing adjacent land or creating new ones (Carmona Ruiz 1998, 127 f.). The *dehesas dehesadas* increased considerably in size and number, so that in many cases they came to occupy a quarter of the available land. This increase was not due to the need for more space to feed the oxen, using these *dehesas* to feed livestock not on the farm. Sometimes the owners managed to close the proprietaries completely, thus turning them into *donadíos cerrados*, where the cattle were fed as allowed by their owners, sometimes charging them a fee for their use (Carmona Ruiz 1998, 152; Ladero Quesada 1976).

The increase in the number of *dehesas* in Seville was so notable that in the mid-15th cent. AD the king Juan II. (1405–1454 AD) cancelled all the *dehesas* that the Seville Council had authorised in the twenty years before, prohibiting it from allowing new *dehesas* to be built without his authorisation. This order was not respected and, in fact, Seville continued to grant permits for *dehesas*, and, as in other areas of Andalusia, the number of private *dehesas* increased considerably between the end of the 15th and beginning of the 16th cent. AD (Carmona Ruiz 1998, 153 f.).

In addition, taking advantage of the food needs of the livestock, the owners of the estates began to usurp spaces for communal use, enclosing them to obtain new income from the renting of their pastures. Among others, examples of this practise are the disputes the Counts of Ureña had with the people of Morón and Osuna (García Fernández 1995), especially the one with Morón, because of the Algaida and Dehesa de Cote. They had been in communal use until access was denied by the

Counts of Ureña, who started to rent them out at the beginning of the 16th cent. AD (Carmona Ruiz 1999). Another example is the case of Arcos de la Frontera, where Don Rodrigo Ponce de León had appropriated communal lands in the district (Carmona Ruiz 2003).

There are countless communal and private *dehesas* that were established around this time, although we do want to emphasise that a large part of them were intended for farm livestock, which was essential for the proper development of agricultural activities. This does not include the numerous private *dehesas* created especially by the lords for profit, and therefore destined for any type of livestock, among which were logically the large flocks of transhumant sheep integrated in the Mesta Real.

In fact, after the conquest of Granada in 1492 AD, transhumant livestock began to arrive regularly in Andalusia. The reasons for this are the development of local livestock, the protectionism deployed by the councils of Andalusia and the permanent danger that the border of Granada entailed. This explains why, even though the Crown always contemplated the possibility of using the pastures of the south, in fact during the medieval period the *mesta* (an institution established in medieval times) played little role in the region, limiting its presence to points located in the Sierra Morena area (Argente del Castillo Ocaña 1991, 284 f.). Despite the interests of the lords in leasing their pastures, the situation of many of the lordships on the border meant that the *mesta* livestock breeders, faced with the danger of the *razzias* from Granada that continually devastated the area, did not risk to use these territories. Only after the definitive destruction of the kingdom of Granada they moved there. On many occasions the *mesta* livestock was forced to cross the lands of the councils of the royalty until they reached the lordships. Given the impediments the lords placed, the operation could become quite complicated. All this explains that it would not be until the disappearance of the danger of the border at the end of the 15th cent. AD that transhumant livestock began to proliferate in these lands.

The inclusion of the Andalusian lands into the Hispanic transhumance networks was favoured by the power that the *mesta* acquired from the

reign of the Catholic Kings, the disappearance of the Muslim danger and the financial problems of some councils that tried to solve them by leasing their lands to the transhumant pastoralists. Also, by that time the load of debts on pastures in lands of dominion increased notably. This situation was much easier in the lordships that arose at the end of the 15th cent. AD in the lands of Granada, such as in the Villaluenga mountain range, where the Duke of Arcos had large and numerous *dehesas*. In contrast, in those places that had previously belonged to the royal jurisdiction or an important council autonomy, the lords clashed head-on with the interests of their neighbours, since the latter intended to keep all the vacant land open for the use of common people. This is the case in the lands of Niebla or the lordship of Osuna. However, despite the opposition, the lords made numerous leases (Carmona Ruiz 2007).

The benefits that some individuals tried to secure by establishing and renting of *dehesas*, meant severe damage to the economy of some municipalities, because of the loss of land for grazing.

Conclusions

Through these pages we have been able to see that since the Christian conquest a large number of *dehesas* have been created in Andalusia. The first ones to appear were the *dehesas boyales*, in order to guarantee the feeding of the working cattle belonging to the local people. These *dehesas* appeared in the communal areas and although their extension varied from one place to another, in general, they were created in places with good pasture and water and easy access for the cattle to which they were destined. From then on, and throughout the centuries, the number of *dehesas*

increased gradually, preserving some spaces for other types of livestock and for the exclusive use of the neighbours. This growth was especially important from the 15th cent. AD onwards when the number of *dehesas* increased notably, as a result of the increase in spaces for agricultural use and the consequent decrease in uncultivated spaces. This reality explains the confrontation between farmers and ranchers and the appearance of new *dehesas* which were intended to guarantee food for the local livestock. In this sense, we must highlight the notable increase in the number of *dehesas* in the mountain areas from the 15th cent. AD onwards.

All this also explains the considerable increase in the number and extension of private *dehesas*, many of which were created to feed the owners' livestock, but in many other cases were intended for renting out and obtaining economic benefits. In this respect, it is worth noting the large amount of land that the nobility reserved in their lordships as pastureland to be leased to local and transhumant livestock. Parallel to this reality, some community uses were restricted, such as the Defeat of Miseses, and in fact, at the end of the Middle Ages, the stubble fields, which in principle were for communal use, began to be sold, benefiting the owners of the farmland, who were mainly the local authorities and the nobility.

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Bibliography

- Aranda García 2016*: J. A. Aranda García, De pastores y caminos. Trashumancia en el Alto Guadalquivir en época romana. *Antiquitas* 28, 2016, 39–64.
- Argente del Castillo Ocaña 1988*: C. Argente del Castillo Ocaña, Los aprovechamientos pastoriles en la Frontera Granadina. In: E. Cabrera Muñoz (ed.), *Andalucía entre Oriente y Occidente (1236–1492)*. Actas del V Coloquio Internacional de Historia Medieval de Andalucía (Córdoba 1988) 271–280.

- Argente del Castillo Ocaña 1991*: C. Argente del Castillo Ocaña, La ganadería medieval andaluza. Siglos XIII–XVI (reinos de Jaén y Córdoba) (Jaén 1991).
- Argente del Castillo 1998*: C. Argente del Castillo Ocaña, Las actividades agroganaderas en la Frontera. In: F. Toro Ceballos/J. Rodríguez Molina (eds.), II Estudios de Frontera. Actividad y vida de frontera (Jaén 1998) 73–99.
- Borrero Fernández 1992*: M. Borrero Fernández, La organización de las dehesas concejiles en la Tierra de Sevilla. Historia. Instituciones. Documentos 19, 1992, 89–106.
- Cabrera Muñoz 1977*: E. Cabrera Muñoz, El condado de Belalcázar (1444–1518). Aportación al estudio del régimen señorial en la Baja Edad Media (Córdoba 1977).
- Carmona Ruiz 1996*: M. A. Carmona Ruiz, La Reglamentación de los “Echos” Jerezanos en el Siglo XV. Historia. Instituciones. Documentos 23, 1996, 159–172.
- Carmona Ruiz 1998*: M. A. Carmona Ruiz, La ganadería en el reino de Sevilla durante la Baja Edad Media (Sevilla 1998).
- Carmona Ruiz 1999*: M. A. Carmona Ruiz, El aprovechamiento de La Algaida de Cote (Bosque de San Pablo, Montellano). Siglos XIII–XVI. Apuntes 2.3, 1999, 142–170.
- Carmona Ruiz 2003*: M. A. Carmona Ruiz, La actividad ganadera en Arcos de la Frontera a fines del Medioevo. In: Actas del I Congreso de Historia de Arcos de la Frontera (Cádiz 2003) 285–308.
- Carmona Ruiz 2006*: M. A. Carmona Ruiz, El Caballo Andaluz y la Frontera del Reino de Granada. Cuadernos de Historia de España 80, 2006, 55–64.
- Carmona Ruiz 2007*: M. A. Carmona Ruiz, La Mesta Real y las Mestas Andaluzas. In: A. D. Ortiz (ed.), Historia de Andalucía IV. El nacimiento de Andalucía. ss. XIII–XV (Barcelona 2007) 210–218.
- Carmona Ruiz 2009*: M. A. Carmona Ruiz, Ganadería y frontera. Los aprovechamientos pastoriles en la frontera entre los reinos de Sevilla y Granada. Siglos XIII al XV. En la España Medieval 32, 2009, 249–272.
- Carmona Ruiz 2011a*: M. A. Carmona Ruiz, Los Bienes Comunes y su Papel en la Economía Rural de Carmona. In: M. González Jiménez (ed.), Carmona. 7000 Años de Historia Rural (Sevilla 2011) 285–306.
- Carmona Ruiz 2011b*: M. A. Carmona Ruiz, La ganadería de la Sierra de Constantina en la Baja Edad Media. In: M. Valor Piechotta (ed.), Historia y Arqueología de la Constantina Medieval (Sevilla 2011) 103–126.
- Carmona Ruiz 2012*: M. A. Carmona Ruiz, La presión real y señorial sobre el patrimonio de los concejos Andaluces en la Baja Edad Media. El caso de la *Dehesa* de la Torre de Don Ibáñez (Baeza). In: B. Arizaga Bolumburu/J. Solórzano Telechea/D. Mariño Veiras/C. Díez Herrera/E. Peña Bocos/S. Guijarro González/J. Añíbarro Rodríguez (eds.), Mundos medievales. Espacios, sociedades y poder. Homenaje al profesor José Ángel García de Cortázar y Ruiz de Aguirre (Santander 2012) 1149–1160.
- Carmona Ruiz 2014*: M. A. Carmona Ruiz, Las actividades pastoriles en Jerez de la Frontera. Siglos XIII–XV. In: Congreso 750 Aniversario de la Incorporación de Jerez a la Corona de Castilla, 1264–2014 (Jerez 2014) 195–219.
- Collantes de Terán 1977*: A. Collantes de Terán Sánchez, Nuevas poblaciones del siglo XV en el reino de Sevilla. Cuadernos de Historia 7, 1977, 283–336.
- Collantes de Terán 1982*: A. Collantes de Terán Sánchez, Evolución demográfica de la Andalucía Bética (siglos XIV–XV). In: E. Cabrera Muñoz (ed.), Actas I Coloquio Historia de Andalucía. Andalucía Medieval (Córdoba 1982) 21–33.
- García Fernández 1995*: M. García Fernández, Violencia señorial en Osuna a finales de la Edad Media. In: M. García Fernández/J. J. Iglesias Rodríguez (eds.), Osuna entre los tiempos medievales y modernos (siglos XIII–XVIII) (Sevilla 1995) 195–224.

González Jiménez 1995: M. González Jiménez, Poblamiento de la Baja Andalucía. De la repoblación a la crisis. In: XXI Semana de Estudios Medievales, Estella'94 (Pamplona 1995) 63–86.

Ladero Quesada 1976: M. A. Ladero Quesada, Donadíos en Sevilla. Algunas notas sobre el régimen de la tierra hacia 1500. *Archivo Hispalense* 59, 1976, 19–92.

Linant de Bellefonds 1959: Y. Linant de Bellefonds, Un problème de sociologie juridique. Les terres 'comunes' en pays d'Islam. *Studia Islamica* 10, 1959, 111–136.

Martín Gutiérrez 2015: E. Martín Gutiérrez, Paisajes, ganadería y medio ambiente en las comarcas gaditanas. Siglos XIII al XVI (Cádiz 2015).

Pérez-Embid 1999: J. Pérez-Embid Wamba, Aracena y su sierra. La formación histórica de una comunidad andaluza (siglos XIII–XVIII) (Huelva 1999).

Vassberg 1986: D. E. Vassberg, Tierra y sociedad en Castilla. Señores, "poderosos" y campesinos en la España del siglo XVI (Barcelona 1986).

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The Culture of Water in a Mountain Environment

The Case of Baños de la Encina, Jaén: A View from Tourism

Keywords: water culture, landscape remains, heritage, network of thematic trails, public use, tourism

Abstract

The purpose of this paper is to show how in a territory where the first human occupation created the landscapes of the Argaric Bronze Age of the Rumbal river basin – a mountainous place with scarce water reservoirs, where rains are very rare and when they arrive are torrential¹ – the inhabitants needed to build a diversity of mills and infrastructures that would allow them to obtain and store the water they needed to survive, to produce food and to transform raw materials. They modelled a complex and heterogeneous landscape with water as the main protagonist. Today, as the cultivation of olives dominates the territory, widely homogenising its limits, this heritage has barely survived, except for small territorial islets that, as if they were old relics, reveal a beautiful landscape and retain in their interior a unique, historical and ethnographic heritage, a precious tool for new ways of developing cultural products and destinations for tourism.

¹ In 2018 in Sierra Morena Oriental it rained 575l/m² (Instituto de Estadística y Cartografía de Andalucía; Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible of Junta de Andalucía).

The Territory

The town of Baños de la Encina is located in the first southern foothills of the Sierra Morena mountain range (*fig. 1*), straddling the border between the sierra and the countryside. Its municipal district is dotted and surrounded by several protected natural areas, including the natural parks of the Sierra de Andújar and Despeñaperros and the natural monuments of El Piélago and Los Órganos. Located in the northwestern part of the province, 52km from the capital, its well-preserved historic quarter rises 420m above sea level and some 100m above the fertile lowlands and countryside (the nearby Campiñuela). The geological, edaphic and biotic diversity of its district has allowed the development of a complex economy. Arable land is used for cereals, legumes and vegetables, as well as for vineyards and olive groves. The more mountainous regions combine mining activities and pastures. The town itself is connected to two routes used for transhumance, into the 'Montes Universales' (Cuenca, Teruel and Guadalajara) and into the mountains to the east and south (Sierras de Segura, Cazorla and Mágina). Geologically the village is situated between the Sierra Morena to the northwest and the Guadalquivir depression to the southeast. The former is characterised by schist and Palaeozoic granites, the latter by marine sandstones. Both are separated by the Baños fault (García García et al. 2011, 106).

Contrary to what the name of the village seems to suggest (baths), it does not have its origin in the

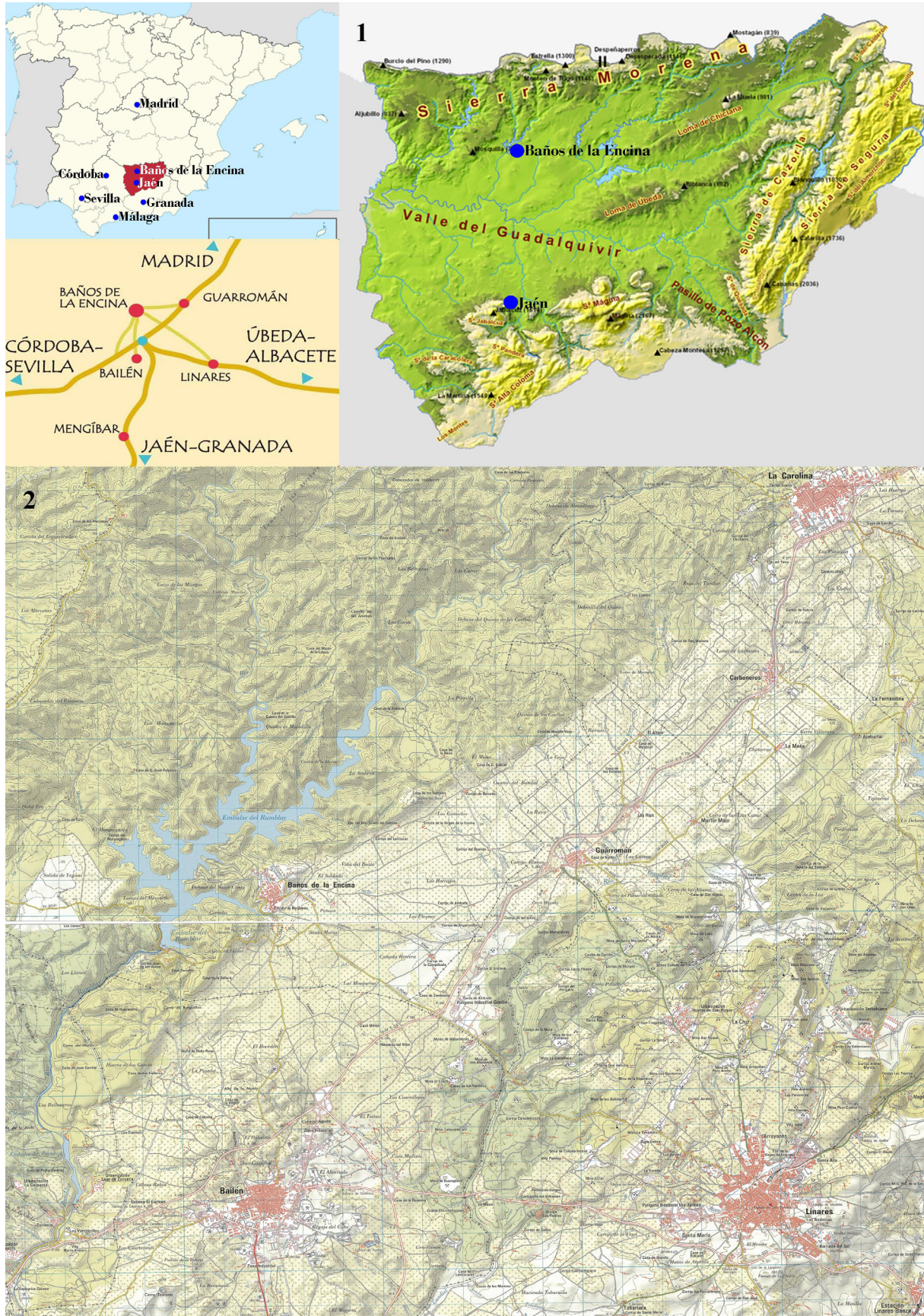


Fig. 1. Baños de la Encina, geographic location. Source: (1) Wikimedia Commons, author: Juan Pedro Ruiz Castellano; (2) National Topographic Map MTN50. Dirección General del Instituto Geográfico Nacional. Ministerio de Fomento.

presence of any *balnea* or *alhama*, nor in an abundance of water of its surroundings or of medicinal springs. There only is the pit of La Campiñuela, a water reservoir from which water has been extracted recently through complex extraction techniques and soundings of several hundred metres depth.² According to latest research, the name *baños* might derive from the phonetic transcription that the first Castilians arriving here made of *banyya*, a possible Muslim name for the castle *hins banyya* (Cantarero Quesada 2019, 79–85; Rueda 1964, 19 f.) that rises on the Cueto hill, the historical germ of the settlement. In Spanish, the classical Arabic term would literally be translated as ‘fortress with deep historical roots’, ‘ancient’ or ‘with a lot of history’. The archaeological excavations (Moya García 2014; Arboledas Martínez et al. 2014a; 2014b) in the fortress and its immediate vicinity highlight the historical and cultural wealth of the place and certify the possibility of this appellation. Between 1147 and 1227 AD, the Mariánico massif had border status during the *reconquista*. The originally Arabic term might have evolved from *bayya* over *bania*, *bannos* to *baños* and for its inhabitants from *bani-oscas* to *bañuscos*.

Water Deficit, Technical Solutions and Landscape Diversity

After the Castilian conquest (first third of the 13th cent. AD), the site of Vannos or Bannos enjoyed a privileged legal status. Although it was dependent on the council and city of Baeza, the village had a pasture of exclusive use or ‘acorn and grass privilege’ and private land under the control of the village council (Muñoz-Cobo y Fresco 1988, 61–63). Still, there was a slow economic development. It lasted until the first decades of the Modern Period (last third of the 15th cent. AD) for the region to see decisive economical growth, fuelled by an intensive agriculture with a growing diversification, a consolidating transhumance

and a profitable road taxation. In 1492 AD, by royal decree, the Catholic Monarchs allowed the village council to collect a road tax in the Port of Baños, Collado de la Estrella or Puerto del Rey, on the Road from Toledo to Granada/Málaga (Ramos Vázquez 2003, 317–321). There was a rainfall regime characterised by sporadic, quasi-torrential rainfall, with scarce reservoirs and an increasing population which had a growing need for water. Perhaps because of this water deficit, and also because of the great geomorphological diversity in such a small space, the inhabitants were forced to find a number of different ways to obtain and store water for daily use, whether domestic, agricultural or industrial. This resulted in a rich ethnographic heritage, mostly related to water, today the calling card of some very peculiar landscape relics.

In the early Middle Ages, when the population was sparse and restricted inside the castle, the water requirements and the hydraulic devices needed were minimal. The cistern of the fortress was sufficient for the consumption of the population, while for the supply of livestock, water was obtained from the wetlands located next to the castle (Charcones and Cantalarranas) and, possibly, from the spring in Calle Mestanza. This spring would eventually provide water to the pillar-trough of the Church of San Mateo, the parish church. In the early Modern Age, when the population increased, the settlement extended outside the castle walls and spread on the slopes of the Cerro del Cueto. The territory began to be domesticated, which included water works. To avoid damage caused by floods from torrential rains, the urban slopes were channelled and corseted, creating narrow and steep water ducts (Precipicio, Fugitivos, Arroyo, Cuidado and others); and the wetlands of the foothills were drained to prevent the spreading of diseases, such as malaria and to obtain fertile land³ suitable for horticultural production and the population’s food supply (*fig. 2*).

2 Identification and characterisation of the interrelationship between groundwater, river courses, spring discharges, wetlands and other natural ecosystems of special water interest, <http://info.igme.es/SidPDF/147000/990/147990_0000004.pdf> (last access 02.12.2021).

3 The existence of the piedmont wetlands was confirmed by a geological study carried out by the Department of Geology of the University of Jaén for the implementation of the ‘Geosendero de la Pizarrilla’. Its results have been presented in the various interpretative panels along the itinerary. Unpublished study.

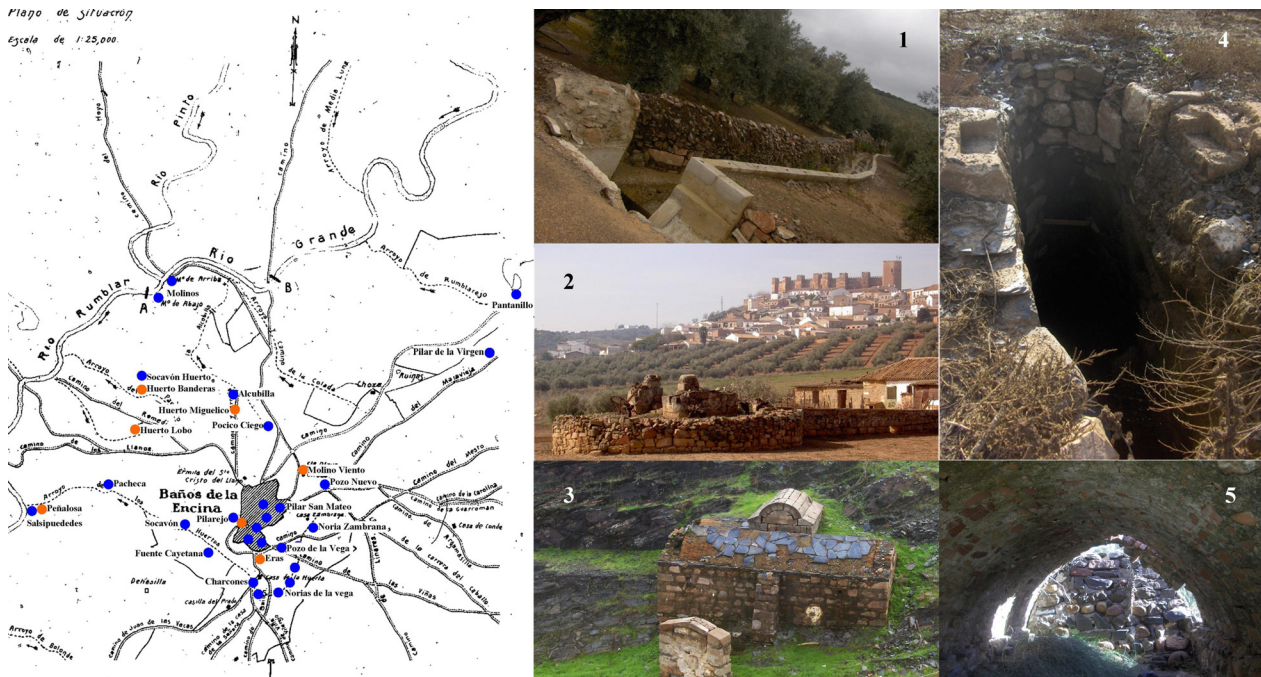


Fig. 2. Distribution of the hydraulic equipments: (1) ditch; (2) waterwheel of Huerta Zambrana, platform and aqueduct; (3) fountain of Cayetana; (4) waterwheel of Morito, Precipice of Valdeloshuertos; (5) mill of Abajo.

This way of intervening into the territory by the construction of hydraulic devices has a long historical tradition. Some facilities related to the culture of water, which have their roots deep in history might be mentioned here, such as the gigantic Bronze Age slate cistern of Peñalosa (Moreno Onorato et al. 2008) or the small balnea of the Roman villa of the Sanctuary of the Virgen de la Encina, which was the embryo of the sanctuary itself, its water coming from a nearby spring, the Barranco del Pilar. Also, there are Los Perales de Purita and Del Polígono, two mortar pools, using the *opus caementicium* technique, possibly of Roman origin. The first today is the support for another more modern and very modest one used for irrigation, while the second is the foundation of a mine shed from the first half of the 20th cent. AD. Other evidence of hydraulic engineering is the double Almohad cistern of the castle and the drainage cisterns of the Alcubilla hydraulic complex (fountain, well and washing place), constructed with lime mortar (possibly medieval).

Most of the waterworks, which today shape the town centre, and its immediate surroundings were built in the period from the 16th to the 18th

cent. AD. The hydraulic assets can be classified into five types according to their field of use: land management, domestic use (drinking, washing, laundry, preparing food, etc.), roads for commercial and livestock traffic, agriculture and industrial management.

Land Management

The aim of this kind of infrastructure was not to organise or regulate the surrounding land, rather it was the result. They were built to redirect rainwater or to prevent damage from floods, as the urban space and its surroundings was organised, its uses were regulated or new land was obtained for cultivation. Two types of construction can be found here. The first type comprises the so-called water alleys: Precipicio, Fugitivos, Arroyo (later separated into Mestanza, Del Pilar and Cuidado), Trinidad baja, Herradores, Barranco, Mazacote and Cuesta de los Molinos. They are road axes that channelled and drained the water from the streets and minimised the damage caused by torrential rains. The alleys were narrow, steep and in most

cases without residential areas, although in many cases they gave access to stables and corrals. In addition, they kept rainwater away from the streets most frequented by the population, reducing risks for people and buildings. As the urban space grew, new streets were laid out, from west to east, cutting through the level lines and making the town safe from floods and floodwaters. This is an exceptional urban landscape, which was a reason for the declaration of the town of Baños de la Encina as a historic/artistic site in 1969.

In the lower part of the village, in La Serna, water from the street was channelled back into the paved ditches of La Campiñuela. With this last channelling, the waters were prevented from stagnating in the old wetlands of Los Charcones and Cantalarranas and were drained to the Barranco de Valdeloshuertos ravine and finally to the Rumber river. With this strategy, damage was avoided and the result was a wedge of fertile land for horticultural use being a stone's throw away from the village: Arenales, Zambrana, Huertas del Camino de Bailén and others.

The second construction type of use for land management encompasses ditches in general, both those for the draining of water from the countryside, mentioned in the previous paragraph, and those which channelled rainwater from the mountain step of the Falla de Baños to the base of the foothills, where it was channelled by the former. In this way, with controlled channelling, major damage to crops was avoided, and the water was correctly drained and collected in very specific places, where the water table was raised and the presence of wells and drinking troughs was favoured (Pozo de la Vega, Barranco de la Serna-Zambrana, Huerto Lucero-Pozo Nuevo or Huertas de los Charcones).

Looking from above the area around the town is completely furrowed by a kind of series of interconnected ditches which, in the form of a fan or funnel, spills water into the Valdeloshuertos stream and then into the Rumber (fig. 2). In this way, new uses were created for the territory irrigated and drained: gardens, orchards and watering places at the foot of the Camino Real, visible today inside the dominating olive growths.

Domestic Use

During the early Modern Age, there was an intense demographic and urban growth and the need to build the necessary facilities to supply water to the population. To this end, more than a hundred single-family wells were drilled throughout the historical complex. They are located in the corrals of the houses. In addition, there are few public wells located in populated places (Pozo Vilches and Pozo del Altozano de la Cuesta de los Herradores).⁴ The brackish water obtained by this method was fit to produce edible bread but not suitable for direct human consumption. Drinking water had to be obtained elsewhere, preferably from the springs of the nearby Barranco de Valdeloshuertos ravine (springs of La Cayetana, Socavón, Pacheca and Salsipuedes)⁵ and other places near the town, such as the Arroyo de La Alcubilla (drinking water), the Barranco del Pilarejo (washing and drying place for clothes) or the Pilar de la Virgen spring (watering place and drinking water). On other occasions and for laundry purposes, garden pools (Charcones and Descolorío) and small pools in streams that ran along geological supports dominated by slate (Alcubilla) were also used.

The demographic and industrial growth (oil processing) that took place well into the 20th cent. AD together with the short but significant distance to the main sources of drinking water (Valdeloshuertos) meant that, after the middle of the century, water was obtained and channelled to the village from a spring in the interior of the sierra (Gorgogil, located some 22km from the town

⁴ 'Despite the fact that Baños de la Encina has some 3,200 inhabitants and, due to its rich olive oil production, has several oil factories that consume a significant amount of water, it does not have a water supply as such. Some houses get their water from wells located within the town, although these are in poor hygienic conditions, while other residents fetch water from small springs located outside the town, some of which are quite far away, and all of which have a very low flow, especially during the dry season' (E. Dupuy de Lomé 1924, Municipal Historical Archive of Baños de la Encina [AHMBE]).

⁵ M. Martínez Rojí, Informe indemnización por ocultamiento de fuentes, 1933. Municipal Historical Archive of Baños de la Encina (AHMBE).

centre). Its purpose was to supply a dozen public fountains, which were built and distributed throughout the streets in 1957.

As an epilogue to this section, it should be pointed out that in a very small area of the town's historic centre, less than five hectares, there are more than a hundred wells for domestic use, which in their day conditioned the interior layout of the houses and, even today, when every built-up metre is a treasure, continue to do so. This has made it possible to preserve an urban landscape that has not lost its historical and cultural identity. Outside the walls of the town, the ingenious *alcubillas*, some of the fountains of the Valdeloshuertos ravine (Cayetana and Socavón), the pillars-laundry and a spectacular clothes dryer (Pilarejo) have been preserved, as well as the historical paths that led to each of these mills. All of this today shapes unique landscape features, such as the Camino de la Cayetana. It is an enormous cut carved into the rock (slate) and at intervals, is dotted with some of these mills (Cayetana fountain, Luzonas well).

Roads

In the past, Baños de la Encina was located at a strategic crossroads in the south of the Sierra Morena, where long-distance roads (Camino de Andalucía), country roads or cattle trails (Cañada de los Serranos, *cañada* from the Alcudia valley or La Plata) met. The southern flank of the town, from east to west, was dotted with a series of complex and monumental wells,⁶ such as the wells of La Vega (crossroads of the Linares livestock trail – the transhumant route of the Pontoneros – and the Camino Real de Andalucía), Nuevo (meeting point of the Camino Real de Andalucía, the Camino de San Lorenzo, the cattle track of Majavieja and the historic country roads of Guarromán and La Carolina) and Los Charcones (where the cattle

track of Bailén joins the Camino Palomar, Camino de Andújar and Camino Real). In all cases, as water supply for herds and flocks, these 'service stations' had wells, stone curbstones, cobbled 'floors' and watering troughs. In addition, there are various elements directly related to the road layout, such as the Charcones bridge, the Cantalarranas ford or different sections of cobbled road, such as the extraordinarily well-preserved Camino de los Romanos.

To the north of the town, in one of the ravines that flow into the river Grande (the main tributary of the Rumblar), is an almost monumental *alcubilla*. Situated in the shade of a historic ravine orchard (Huerto Miguelico), it was the starting point for one of the roads that connected with the neighbouring villages on the northern slopes of the Sierra Morena, in the Campo de Calatrava in La Mancha (El Hoyo and Mestanza) and the secondary branch of another one that ran parallel to it, a little further to the east and headed towards San Lorenzo and Huertezuelas. In addition to a garden in a ravine and a small well, the site had a well, drainage pits (made of mortar and limestone), a basin, a washing place in a well and, a little further away, a second well (Pocico Ciego) and a wide stretch of road carved directly into the rock (slate and granite), known as the Camino de la Picoza (Picoza Road).

Other hydraulic elements to the east of the village, such as the Pilar de la Virgen, a watering place for animals and travellers located on the Camino Real de Andalucía, very close to the sanctuary of the Virgen de la Encina, and a second well made entirely of stone, located halfway between the Navarredonda pasture and the Salcedo oil mill, complete the route.

Agriculture

The ways of obtaining water for these uses have been very varied, whether due to the geological conditions of the terrain, the properties and conditions of the soil that supported production or the type of crop to be irrigated. In this sense, in the south, in the countryside and meadows, where water was more plentiful and the arable land was of better quality, the *norias de sangre*

⁶ 'Another if, with respect to the fact that the Aguaderos are in the Ruedos of this town, and are so precious to the cattle because of the scarcity of water in this territory that by no title can they be hindered from entering, we order that the cattle of the Labor Yeguerio and Zerda can come to the said Aguaderos from the parts where they are found by the Royal Roads, which come to this town [...]' (Araque Jiménez/Gallego Simón 1995, 61 f.).

were overwhelmingly dominant, with almost monumental terraces, large pools, an extensive network of irrigation channels and aqueducts.⁷ To the north, in the harsh mountain foothills and supplying the historic ravine orchards, there are the *socavones* or mines, which cut deep into the rock and obtained water where the slate had been fractured, and the *pozas*, which were built next to the streams, temporarily kept the water from the streams so that it was available in case it was needed for irrigation.

In both cases, whether in the southern orchard surrounded by olive trees or in the terraced orchard in the midst of a reforested area, unique landscapes are preserved.

Industrial Management

Mainly, the water mills and the equipment linked to the olive mills and oil mills for olive milling were used for these purposes. There were the flour mills on the river Rumblar⁸ (Arriba, Grande and Jacarero) and those on the river Grande and La Junta, under Cerro Molinos (Migaldías and Picoza, or upper and lower mills). Related to the oil mills is the presence of a slate and brick reservoir located along the course the Rumblarejo stream, an infrastructure that dammed the waters of the stream, channelled them through a cistern carved into the rock and protected with bricks and directed them to a cistern for later use in the press at the Casería Manrique or El Lentisco oil mill.

The landscape-shaping capacity of the mills on the rivers Grande and Rumblar as well as that of the Santo Cristo windmill, which crowns the

village of Baños, went beyond the banks of the river. These mills were the last link in a complex chain of forestry and pastoral farming, a system of exploitation of the highland areas regulated by municipal ordinances, which was already known from 1742 AD ordinances as *roza de cama*. It encompassed a set of rules and times of use that allowed the coexistence of charcoal burners, cattle and sheep breeders and farmers, and it created a unique habitat where the *torruca*, a mountain dwelling or hut and a series of complementary facilities, such as threshing floors, free-standing bread ovens and pillars, played a leading role.

This cultural heritage not only provides information on the various technical solutions used at different times and by different groups in the history of this municipality but also helps to understand more complex processes which, on a local scale, have shaped the everyday history of a territory that is largely sterile. For, as argued at the beginning of the article, in a territory without karstic water regulation or regulation by snow to attenuate the strong Mediterranean seasonal oscillations, water is a crucial resource, not only for farmers and stockbreeders.

With the second half of the 20th cent. AD came the agrarian revolution (*fig. 3*). For the municipalities of the Sierra Morena de Jaén, and in general for the whole of provincial agriculture, it was a critical period that led to the total disappearance of traditional economic activities and, to a large extent, of the material culture linked to them. A cultural landscape that had been shaped over centuries was thus modified, if not destroyed. In the course of this process, the traditional paths, the *torruca*s, the *hortalejos*, the threshing floors, the *pilarejos*, the *rajales* and beehives disappeared, between dumps and dunghills, which appeared everywhere. Fountains, wells and wellsprings died, their springs were clogged with filth, while mills and farmhouses deteriorated (*fig. 4*). At the same time the vine arbours were cut by the vine and the calm lands were covered with endless rows of olive trees. Even the fertile orchard lands were reduced by this aggressive expansion of oil production. The colour of the landscape turned into a uniform grey-green and the traditional water culture that these uses had created was relegated to the status of a relic.

7 'That in the irrigated land of the Huertas named la del Burruncal, those of the Camino de Bailen, the one in the middle of the Charcones, and the one of the Pozo de Valde los Huertos, which are in the Ruedos desta Villa [...].' Respuestas Generales del Catastro del Marqués de la Ensenada, Baños de la Encina, Question 12, 1754.

8 '[...] and that there are only two sand mills with two stones each that grind with the water of the Errumblar River [...] and that between the Mojonera, of this district and that of the Villa de Baylen, there is another mill with one stone [...]. And that in this district, and on the same river, there have been two other mills [...] that are entirely ruined [...].' Respuestas Generales del Catastro del Marqués de la Ensenada, Baños de la Encina Question 17, 1754.



Fig. 3. Landscape evolution of Los Ruedos and Campiñuela. The olive grove threatens to take the fault and swallow the castle. In the photograph above, belonging to the sixties of the twentieth century, you can see the total domain of the land of calm (cereal and legumes). On the contrary, in the one below (today), the olive grove is the absolute owner of the landscape; since it is only absent in the 'islets' where some public facilities are preserved, such as the Roman Road and the Eras, and where the slope prevents its cultivation.



Fig. 4. Quite bad conserved heritage: (1) dumps and tips; (2) Guarromán 'Cordel'; (3) Los Charcones Bridge; (4) windmill of the Santo Cristo; (5) Piedra Escurridera, tip; (6) Pocico Ciego, well.

A Network of Thematic Trails as a Tool for the Preservation of Water Culture Landscape Relics

After the first half of the 1990s, the first voices began to be raised in the municipality demanding the implementation of comprehensive actions for the defence and preservation of local heritage, as until then they had focused solely on monumental heritage. 'Integral' was understood as the necessary attention to other types of assets, such as those of ethnographic, archaeological or immaterial nature: historical cobblestones, mills, caves and tunnels, archaeological sites and enclaves, traditional games and historical roots, but also pillars, water troughs, wells, *alcubillas* and even the songs and sayings that were said when fetching water from the fountains. At that time, the institution that led the way and spearheaded this whole process was a workshop school, a training programme for people under 24 years of age that alternated theoretical content and real-life practical work. Specifically, it was the 'Rural Tourism Workshop' which led the initiative to learn about and promote the conservation of this heritage (by organising training and informative workshops and printing various informative material). They drew on paper the first trails that would connect a good number of this type of assets (which ran through the area closest to the town centre) and signposted six of the trails proposed in the draft, although with very few resources. To this end, they installed at the beginning of each route a panel presenting the route and directional posts (made of treated pine wood) at each of the crossroads. Although the intervention was minimal, and hardly affected the improvement of the existing heritage along the signposted paths and the associated landscape, it did lay the seed for what would soon become the two first footpaths approved by the Andalusian Mountaineering Federation (PR-A 288 Sendero del Bronce and PR-A 289 Sendero de La Verónica).

It was during these years that, because of these initiatives, the foundations were laid for the future organisation and creation of a network of footpaths that would form the backbone of the territory surrounding the town of Baños de la Encina. The main objectives for the road network were the safeguarding of the small relics of the water

culture around the town of Baños de la Encina, the recovery and dissemination of the ethnographic heritage of these landscape islands and the social use of the traditional paths that were the backbone of this network of hydraulic devices.

Generally, the project for the implementation of the Network of Thematic Trails (developed mainly during the years from 2007 to 2011) affected the sites known as Los Ruedos, located to the southeast of the town and La Dehesa del Santo Cristo or del Llano, located to the north and west of the urban area. It is a large area, which encloses the town of Baños de la Encina. It is municipally owned and traditionally used by the local population. Formerly a border area between the populated and agrarian areas, it degenerated into a series of illegal rubbish dumps. The historical roads were blocked, ploughed and plundered by the neighbouring properties. Their hydraulic mills, many of which had been demolished, were hidden underneath waste. More specifically, the project cared about the places known as Camino de la Cueva de la Mona (or Ancho), Pozo de la Vega, Aprisco de los Charcones, Vereda de las Aguas in its section at the tail end of the Valdeloshuertos reservoir, Camino Cascarrillo, Pozo Nuevo, Cordel de Guarromán, Piedra Escurridera, Arroyo de la Alcubilla, Piedras Bermejas, Canteras del Santo Cristo and Barranco del Pilarejo. In all, it was a wide circular band that surrounded the entire urban perimeter of the town.

Implementing a Network of Thematic Trails was aimed at the comprehensive recovery of the historical and traditional paths and the landscape relics in the town's historical *dehesas* (lands of former communal use), including those elements of its ethnographic heritage that gave each specific landscape relic its own identity. Thus, a green perimeter with a high cultural, ethnographic, archaeological and environmental load, was created for public use to replace rubbish dumps, wasteland and ruined buildings that separated the centre of Baños de la Encina from its agricultural surroundings.

After the closing of the aforementioned Workshop School, it was the Environment and Tourism Department of the Baños de la Encina Town Council that took over the responsibility for the project. To this end, the council had the financial support

of the Department of Tourism and Sport of the Andalusian Regional Government, either through the annual call for subsidies published in BOJA (Boletín Oficial de la Junta de Andalucía) under the line ‘tourist infrastructure’, or through the aid provided by the various Sustainable Tourism Initiatives that brought together municipalities from different territorial areas: RedPatrimonia (23 monumental municipalities from all over Andalusia), ADIT Sierra Morena (localities of the maritime massif) and the Paisajes Mineros de Jaén Programme that integrated three towns of the province sharing a mining history: Guarromán, La Carolina and Baños de la Encina. In addition, there was occasional financial and advisory support of the Provincial Council and the never ceasing dedication of the Department of Prehistory and Archaeology of the University of Granada and the ‘Peñalosa Project’ led by Professor Francisco Contreras Cortés.

The particularity of these trails is their peri-urban layout. They can be used by local residents, who thus identify with their own history. But they are frequented by visitors, who come to the town interested in the monumental heritage of the municipality, so they can complement their visit with these historic themed trails.

In addition to the geodiversity and rich landscape of the territory, there is also an outstanding archaeological heritage and remarkable natural spaces that have been extensively anthropised throughout history. All this allows the possibility of relating those landscape relics with human occupation and the capacity of the population to domesticate their environment, but also with the artistic-cultural heritage and the customs and uses that the inhabitants of the area have given to the territory (Cantarero Quesada 2016).

The Network of Thematic Paths now has four itineraries that share common sections, so they encircle the entire urban centre. The historic centre and the more modern streets connecting the different scenic relics. The road network implemented has recovered a unique ethnographic heritage without which it is impossible to understand the history of this municipality. At the same time, these paths have been transformed into an ideal setting for educational, cultural, identity, environmental, recreational and sporting uses and purposes.

As mentioned above, four trails have been implemented. Each one of them, as an interpretative axis, revolves around a subject that gives it a didactic sense (geology, archaeology and environment), although they are supported by complementary areas such as ethnographic heritage, agriculture, forestry or historical-artistic resources that are dotted along the route.

The first, the Geosendero de la Pizarrilla,⁹ has geology as its thematic axis and provides a circular route that allows to go around the entire town centre (*fig. 5: 2*). The path, which at all times keeps the village hamlet in sight, includes the outstanding geological landmark of the Baños fault, as well as other complementary features such as the Nacimiento river pit (Campiñuela), the galena trench of El Polígono, the tabular sandstone table of Cerro de la Calera, the porphyry dyke of Arroyo de la Alcubilla and Piedras Bermejas or the slate ‘sea’ of Dehesa del Santo Cristo. It offers contrasting areas as the orchards of the fertile plain, the ravine orchards of the mountain foothills, the rough slopes or the reforestation areas of the Franco dictatorship (pine and eucalyptus), which contain archaeological sites like the Argaric fort of Migaldías or Cerro Molinos. Along the route, there is a string of small landscape relics in which the culture of water plays an important role, such as Pozo Nuevo, Pocico Ciego or Piedras Escurridera. These are very characteristic wells, almost monumental and of roadside origin. Pozo de la Vega stands out: it is located at the crossroads formed by the Camino Real de Andalucía (in the section known as Casarrillo) with the Linares cattle track, and whose phreatic pocket is fed by a water channel (from the Arroyo-Cuidado-Trinidad). This signposted path runs along places of historical, geological and cultural interest and bears witness to them, for example in the section Camino de la Picoza (part of the Camino del Hoyo), which is carved directly out of the geological support of slate and granite dykes.

The path has a secondary optional branch: the so-called Sendero de La Verónica, a path approved as a short route (PR) by the Paths Committee of the Andalusian Mountaineering Federation.

⁹ <<http://elcotanillo.blogspot.com/p/geosendero-de-la-pizarrilla.html>> (last access 09.11.2019).

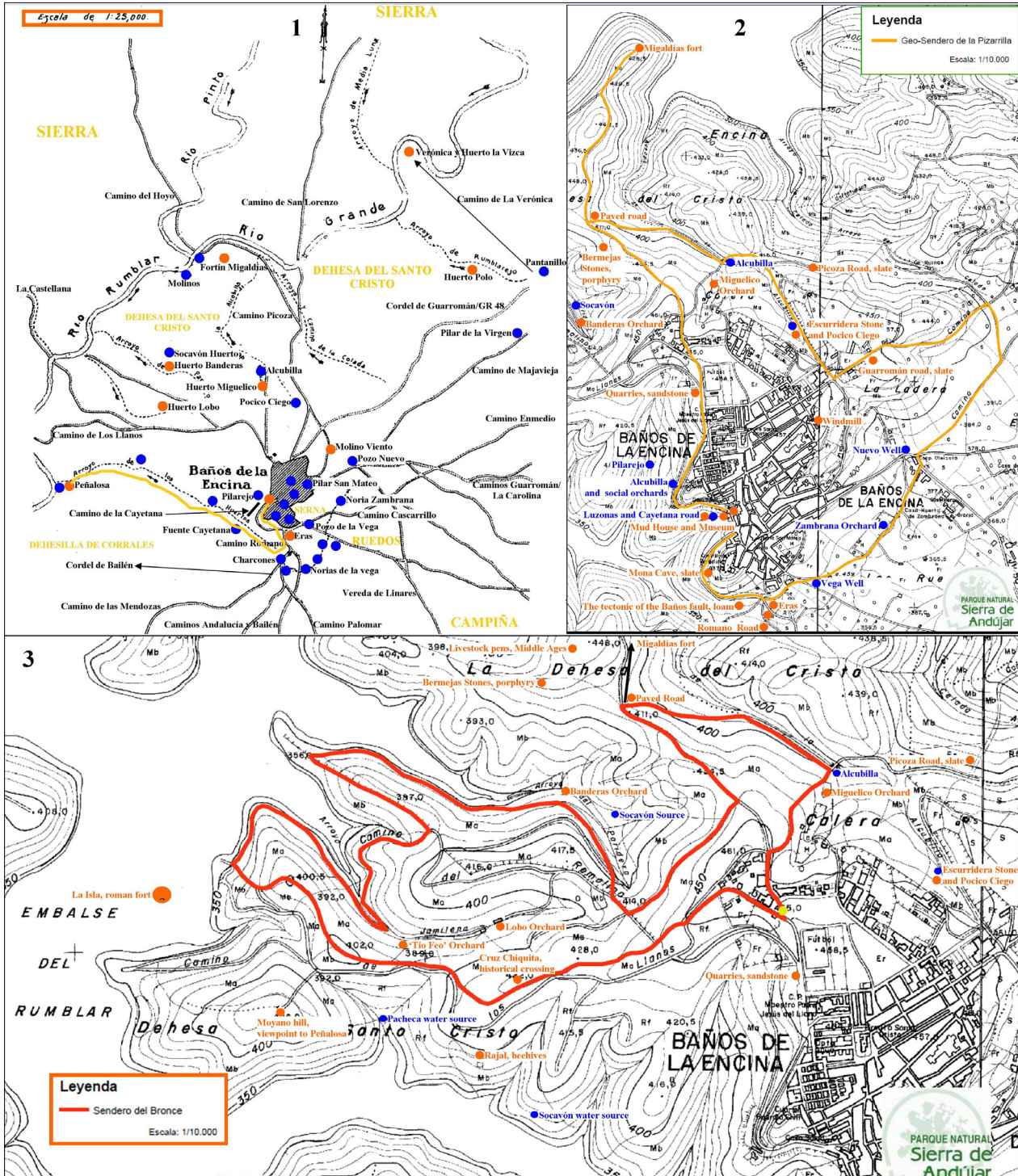


Fig. 5. The trails and their geographical setting. Distribution of roads and sources: (1) Vera de las Aguas; (2) Geosendero de la Pizarrilla; (3) Bronze Trail.

It leads to the Bronze Age site of the same name and, although it is not circular, it can be done independently of the Geosendero de la Pizarrilla (the return trip along the same route totals almost 12km) or integrated into a larger scale trail, the GR 48 Sierra Morena, in its Baños de la Encina–La

Carolina section.¹⁰ The detour adds 4km to the route. Most of the path runs along the Cordel de

¹⁰ <<https://elcotanillo.blogspot.com/2011/08/sendero-de-gran-recorrido-gr-48-sierra.html>> (last access 09.11.2019).

Guarromán, a cattle track with large areas of pastureland, some patches of scrubland and large reforested pine woods. In its final stretch, when it leaves the cattle track behind (and therefore the GR 48 route) and turns northwest, there is a holm oak wood with the presence of *majoletos*, mastic trees and some pyramidal trees. Along the route of the GR there are small scenic islets, scattered along the streams along which the path runs. In one of them, in the Rumblarejo stream, the small reservoir that supplied water to the Casería Manrique oil mill is located. In the vicinity of the path there are some of the old orchards in the ravine, which rise up like fossilised relics anchored in time.

The Bronze Trail,¹¹ which is also circular, runs entirely through the Dehesa del Santo Cristo to the northwest of the village (*fig. 5: 3*). Its subject is environmental issues, which are the result of a long history of forestry and grazing, and are complemented by the presence of ethnographic and archaeological assets. As an archaeological stimulus, there is a panoramic view of Peñalosa from the Cerro Moyano hillock and the presence of the Argaric fort of Migaldías, also known as Cerro Molinos. Among scenic islets, it is worth mentioning the outstanding ravine orchards, the so-called Arroyo del Paridero or ‘Banderas’, and the aforementioned Alcubilla. The latter is located in a wide-open space in the middle of the forest, in a beautiful spot surrounded by eucalyptus and reforested pines (1950s). It is an orchard in a ravine, which obtains water from a well and pools of a stream, and an old refuelling area that supplied water to passers-by on the Camino del Hoyo, a road that connected the two sides of the Sierra Morena. The hydraulic complex has a well, drainage ditches, a washing place next to the stream and a fountain, the latter of a more modern design.

La Vereá de las Aguas¹² was the last signposted path to be implemented (*fig. 5: 1*). While the initial route crosses the old Ruedos – land that was once used for different communal purposes – and

a stretch of the wedge of orchardland reclaimed from the Charcones wetlands (now covered by one of the seemingly expanding olive groves), the second part of the route follows an old path, which in the past was used for the maintenance of the Rumblar reservoir. ‘Verea de las aguas’ is the origin of the name of the path, as about two thirds of the route runs parallel to the water catchment area of the so-called ‘tail’ of Valdeloshuertos.

The subject of the path is mainly archaeological heritage, although it uses ethnographic and environmental assets for educational and touristic purposes. The main proponent is the Bronze Age site Peñalosa. As the name itself evokes, the assets related to water culture present in the Barranco de Valdeloshuertos or Los Huertos also play an important role. In the interior of these two artificial domains, olive grove and reservoir, as if it were a tiny, discordant speck, there is a small island in the landscape: the Los Charcones livestock sheep pen. This is an old sheepfold or resting place for transhumant flocks, with wells, watering troughs and paved floors. In addition to its own ethnographic value, its surroundings are dotted with a collection of heritage assets that derive from old uses (roads, vegetable gardens and communal arenas): cattle tracks, bridges, stone *bardales*, waterwheels and pools, cobbled paths and threshing floors, vegetable garden huts, washing places, quarries and ditches and others.

As already mentioned, the final destination of this trail is a visit to Peñalosa, a population centre of the Argaric culture in the Rumblar river basin. The adaptation of the path (recovery of the islet of Los Charcones, consolidation of the route, construction of a footbridge to save and installation of the directional milestones) and interpretative signposting of the route, together with the parallel excavation campaigns and consolidation and interpretation work at the settlement, have been decisive factors in the rise of visits to the site. All of this has favoured its reinforcement as a cultural and identity component of the local population and the creation of unique tourist experiences, of interest to the cultural or ‘orange’ tourism segment.

The implementation of this complex network of footpaths would not have been possible without a series of prior actions which made the walking scenario a tangible physical reality and without

¹¹ <http://elcotanillo.blogspot.com/p/senderos_03.html> (last access 09.11.2019).

¹² <<https://elcotanillo.blogspot.com/2011/01/verea-de-las-aguas-penalosa-1.html>> and <<https://elcotanillo.blogspot.com/2011/01/verea-de-las-aguas-penalosa-2.html>> (last access 09.11.2019).



Fig. 6. Milestones of the Network of Paths: (1) under construction; (2) direction and indication; (3 and 4) of beginning; (5) of indication of a good, in this case cobbled road of San Lorenzo.

a series of subsequent actions which give utility and content to the road network and promote it as a cultural, environmental and sporting tourist destination.

Paths

In relation to the physical support for mobility, the paths, a twofold strategy was proposed. On the one hand, these paths had to be precisely located and they had to be passable; on the other hand, it was essential to give an own character to the network. For this, once the paths had been identified, their public ownership had to be certified. As the first real initiative, an inventory of all the public paths in the municipality of Baños de la Encina

was drawn up, a work supported by means of a Registry certification (land registry) and approved by the plenary session of the corporation (town council).

In order to restore the old roads, the next step was to recover the original routes and consolidate the surfaces of the historic roads. A complex task was to recover the stone walls, called *bardales* in the local jargon, which flanked the paths and separated them from the adjoining private properties – the same ones that were encroaching on public property. At the same time, in order to preserve the old paths, the rubbish dumps that threatened to engulf the paths were sealed and regenerated with vegetation and, where possible, native botanical species were introduced to make hiking as pleasant as possible.

For the signs that were to indicate the directions, milestones imitating the pillars that traditionally had been used to mark the boundaries of agricultural properties were built (*fig. 6*). The pillars in each case were built with the rock through which the path ran: sandstone, slate or granite. In addition, on the front of the pillar and on a local sandstone slab, the information was carved. The stone used was obtained and worked by local craftsmen (stonemasons and stonecutters), the same ones who devised the typology of the pillar and adapted its base as a possible shelter for a territorial species endemic to the area: the ocellated lizard.

Landscape Relics

The different landscape islets selected, either because of their heritage assets or because of their strategic function alongside the paths, were protected and fitted out as areas for public use (recreational, cultural, educational and social). To this end, and to enhance the value of the landscape islet itself, a range of hydraulic devices and elements were protected, conserved, consolidated and rehabilitated: those that were once in daily use, whether they were used by neighbours, transhumant stockbreeders or travellers, as was the case with wells, water troughs or livestock pens. These same areas for public use were equipped, always with the utmost discretion and trying not to diminish the value of the protected assets, with wooden benches, picnic tables, drinking water, native vegetation (recovery of Mediterranean scrub) as well as wooded and shaded areas.

Other Heritage of Complementary Interest

Action was taken not only on elements of water culture in the landscape relics, but also on assets of heritage interest that were not part of any of these islets (*fig. 7*). In some cases, intervention was taken because the property was next to one of the paths and its improvement would enrich it, as occurred with the Cueva de la Mona or the Roman Road (*fig. 7: 1*). In others, the historical, cultural and touristic interest of the place made its

recovery necessary, even if this was not originally planned. When the spot in question was not right next to the historical path, there were some paths that deviated minimally to integrate it into the itinerary, as happened with the Windmill. There were also other situations in which the path was implemented to facilitate the visit of one of these spots of interest, as was in the case of Peñalosa.

Archaeological projects were supported as well, the same ones that the 'Peñalosa Project' had been developing for decades: excavation, consolidation and enhancement for tourism of different sites, such as Peñalosa, Fortín de Migaldías, the José Martín Palacios Mine and the Trinchera del Polígono-Contraminas. No less important was the protection and restoration of public buildings intended for traditional uses of different types (production, commerce, education, etc.). This was the case of the Plaza or Mercado de Abastos, the dilapidated Santo Cristo windmill and the old Santo Reino primary school. All of them were located in enclaves significant for the project, as they were the starting point of a footpath or the meeting point between a footpath and the urban nucleus. The first was adapted as a workshop for historical and traditional ceramics, under the name of La Casa del Barro (house of clay), the second is home to the permanent exhibition 'Historias al Viento' and the last is the municipal tourist office and houses the Museum of Territory 'Torreón del Recuerdo' itself and, in the courtyard, the recreation of a Bronze Age mine and a 'Classroom of Archaeology'.

Public Use

Once the physical implementation of the trails had been completed, the essential step was for the population to make use of these spaces, whether for cultural, sporting, identity-related or recreational purposes. Different didactic-recreational programmes were developed with practical field trips. Each of them responded to and sought to attract a different segment of the population.

- Raíces (Roots) Programme: this was organised for several years by the Environment Department of the Town Council with the collaboration of the schools in the municipality,



Fig. 7. Interventions: (1) recovery of the Road of Cueva de la Mona; (2) bridge of Charcones; (3) debris removal of the Pocico Ciego; (4) removal of the debris from the Piedra Escurridera, viewpoint; (5) cleaning and recovery of the site of La Alcubilla, well, *alcubilla*, irrigation ditches and new watering hole, that feeds on the overflow of the *alcubilla* itself.

both primary and secondary. It offered a wide range of field trips on foot and a significant educational character. With the help of different local companies dedicated to offering guided activities and in agreement with teachers and professors, the schoolchildren got to know their geographical framework (historical, natural and cultural) through various excursions adapted to the age groups (two excursions per school year). These excursions included various subjects that allowed children to learn about geology and vegetation, mycology and ethnographic heritage, beekeeping and olive culture, religious and industrial buildings and so on, for a total of 16 field trips.

- Latidos de la Tierra (Heartbeat of the Earth) Programme: mainly aimed at tourists and visitors, although it did not exclude the participation of local residents, it offered a series of free activities and field trips of a markedly recreational nature. Financed and devised by

the Tourism Department of the Town Council, they were offered by the different local companies dedicated to the provision of activities and guided tours. The programme was advertised on a quarterly basis and was thematically adapted to the seasons of the year (summer: fire, autumn: wind, winter: stone, and spring: water). It offered different leisure activities (cultural, sports, entertainment) with a good number of excursions to the countryside that was covered by the Network of Thematic Paths as a stage.

- Paisajes Dormidos (Sleeping Landscapes) Programme: along the same lines as the previous programme, the Museum of the Territory developed hiking routes accompanied by an interpreter guide, although in this case they were aimed at groups of local residents: different cultural associations, groups of retired people, students from Guadalinfo or the Adult Education Centre, and so on.



Fig. 8. Landscape islets: (1) Bronze Trail and distribution of heritage assets; (2) the islet of Alcubilla, at the top of the photograph, Miguelico Orchard; (3) Los Charcones; (4) Pocico Ciego; (5) Pozo de la Vega.

As an example for the success of these measures, the Red de Senderos has since been the venue for various sporting events of different disciplines and categories: Legua Nocturna La Bellota, Pies Negros Trail and others. Several times it has hosted the Andalucía Bike Race, the most renowned MTB race in Spain and one of the most outstanding bike races in Europe (*fig. 8*).

Promotion

Once the Network of Thematic Trails had been built, it was no less important to carry out promotional work. In order to disseminate the trails, maximum interest was placed on a tool that was considered ideal for this purpose: its possible integration in hiking networks of greater recognition and promotion that, indirectly, would help it to

promote itself. In this sense, there was the Footpath Network of the Andalusian Mountain Federation (through the homologation of our footpaths as Small Routes) or the set of Footpaths for Public Use of the Sierra de Andújar Natural Park, a protected natural space where the municipality of Baños de la Encina is integrated. To this end, the interpretation panels distributed along the different trails are of the 'panoramic table' type and are governed by the regulations of the 'Manual de señalización de Uso Público' of the Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible de la Junta de Andalucía, while the directional signs follow the homologation criteria that govern the Senderos de Pequeño Recorrido, under the protection of the International Hiking Federation. As an instrument of integration in larger territorial scales, the trails have been constituted as a complementary offer of a main branch or Great Route Trail,

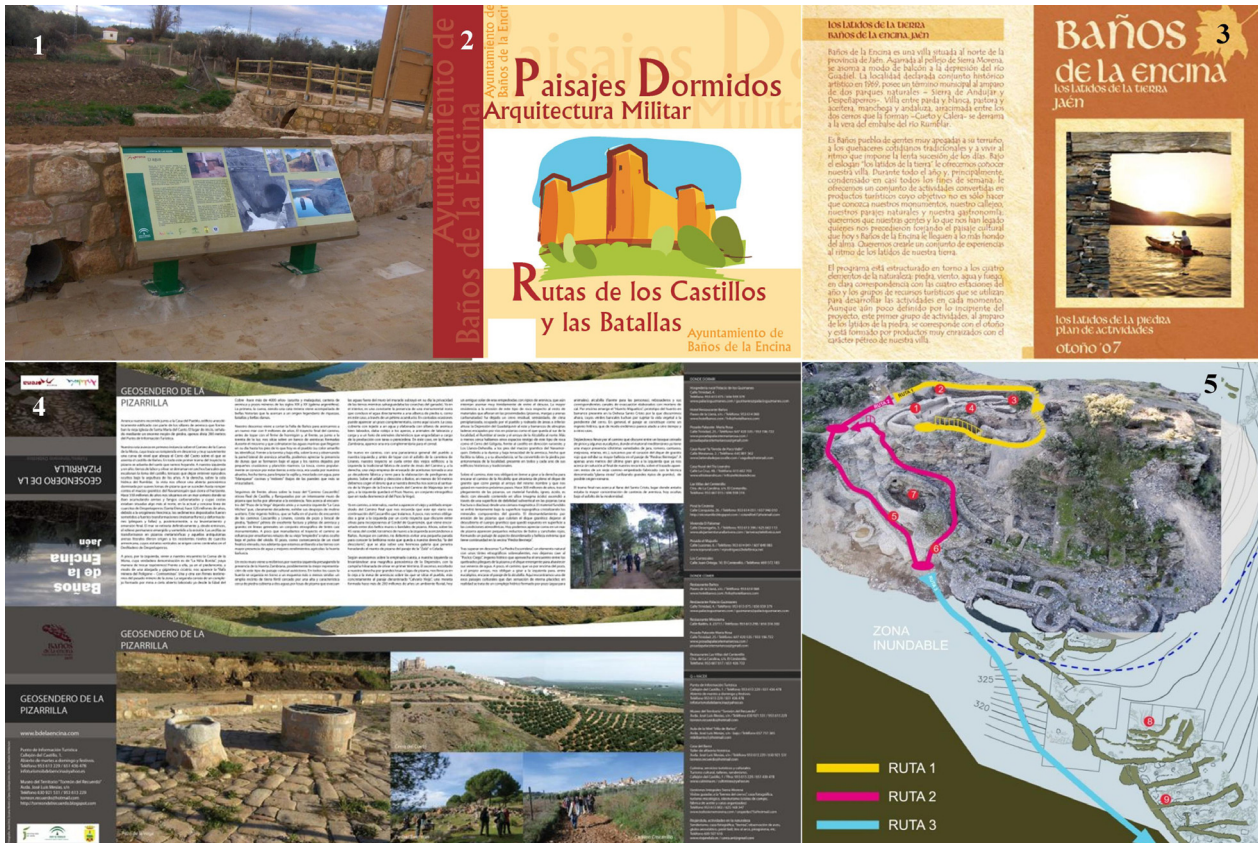


Fig. 9. Interpretive and promotional material: (2) interpretive panel in Los Charcones, 'Verea' de las Aguas; (2) defensive architecture brochure; (3) 'Latidos' brochure; (4) Geosendero de la Pizarrilla brochure; (5) practical brochure for visits to Peñalosa.

the GR 48 Sierra Morena. This makes it possible to link our trail with others of greater territorial significance, in this case with the whole of the Sierra Morena, from Portugal to Despeñaperros. As a result of this work, and as mentioned above, two of the trails have been approved by the Andalusian Mountaineering Federation as 'short distance': the PR-A 288 Sendero del Bronce and the PR-A 289 Sendero de la Verónica (alternative branch of the Geosendero de la Pizarrilla). For its part, the Governing Board of the Sierra de Andújar Natural Park has approved and included the Senderos del Bronce and the Geosendero de la Pizarrilla in its Network of Footpaths for Public Use (fig. 9).

For the drafting and design of the interpretation panels, the Department of Geology of the University of Jaén (which also carried out the research work on the Geosendero) and the members of the Peñalosa Project from the Department of Prehistory and Archaeology of the University of

Granada provided support, mainly for the Vereas de las Aguas, although not only for this trail. Together with this interpretative equipment (fig. 9), different field notebooks, guides and fold-out leaflets were published which were used in promotional activities and are a support tool for hikers. This material indicates at all times where the hiker is, explains the sites and heritage that can be seen along the route and shows how these assets have influenced the daily life of the inhabitants and the local history, as well as how they have participated in the shaping of the landscape.

An example is the field notebook on the subject 'Society and its Environment. Geosystem, Territory and Landscape' taught by José Gómez Zotano, lecturer at the University of Granada, (extracted from the field notebook 'Geosendero de la Pizarrilla' published by the town council of Baños de la Encina and texts by José María Cantarero Quesada), which notes:

‘[...] After descending past La Piedra Escurriera, a natural element with outstanding ethnographic dyes, we drop down to the Pocico Ciego, a hydraulic device that takes advantage of the encounter between the broken folds of the slate and the emerging dam to supply its water springs. Shortly after, the path, which goes over the well, and the stream itself, oblige us to turn left and, amidst eucalyptus trees, face the spot of the *alcubilla*. Here we find one of those cultural landscapes that give the sensation of eternal placidity; in reality it is a hydraulic complex made up of a well (water for animals), *alcubilla* (spring for people), overflow channels and their corresponding evacuation channels made with lime mortar. Above emerges the ‘Huerto Miguelico’, the prototype of the ravine orchard in the Dehesa Santo Cristo through which we are now passing, whose green terraces struggle to hold the plant life to the slope of the hill. In general, the site is constituted as a hydraulic ingenuity that in an endemic way seems to be tied to another time and other uses [...].’

All this information and publicity material, like the one cited above, was integrated into different web spaces, was widely disseminated through the social networks and was used in many promotional activities in which the municipality was participating, either directly or as part of the region: fairs, work-shops, familiarisation and press trips, visits by bloggers and influencers and so on.

Conclusion

All these projects and promotional initiatives made the trails part of the wide range of activities that the Municipal Tourist Office offers, to all types of tourist segments. Several departments of the Universities of Jaén and Granada (mainly those of Prehistory and Archaeology, Geology and Geography) use these trails as a scenario for the field trips for their students.

The physical integrity of the traditional paths and the conservation of these landscape relics were two of the fundamental objectives of the implementation of the Thematic Paths Network programme, but no less important was the recovery of the historical memory of these territories and the allocation of new public uses for their water mills and traditional production areas. Here, the local population played a leading role, as they did not hesitate to reoccupy these spaces, delve into their memory and build new social uses in accordance with the history of their cultural landscape.

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Bibliography and Further Reading

- Araque Jiménez et al. 2005*: E. Araque Jiménez/J. M. Cantarero Quesada/A. Garrido Almonacid/E. Moya García/J. D. Sánchez Martínez, Sierra Morena, una lectura geográfica para un destino turístico en ciernes. Cuadernos de Turismo 16, 2005, 7–48.
- Araque Jiménez/Gallego Simón 1995*: E. Araque Jiménez/V. J. Gallego Simón, Regulación Ecológica en Sierra Morena. Las Ordenanzas Municipales de Baños de la Encina y Villanueva de la Reina. Segunda mitad del siglo XVIII (Jaén 1995).
- Arboledas Martínez et al. 2014a*: L. Arboledas Martínez/F. Contreras Cortés/A. Moreno Onorato, La explotación minera antigua en Sierra Morena Oriental y su vinculación con el territorio. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 24, 2014, 111–145.

- Arboledas Martínez et al. 2014b*: L. Arboledas Martínez/J. M. Román Punzón/J. J. Padilla Fernández/S. Moya García, Poblamiento ibérico y romano en Sierra Morena oriental: el castillo de Burgalimar (Baños de la Encina, Jaén). *Zepirus* 73, 2014, 171–193.
- Argente del Castillo Ocaña/Rodríguez Molina 1983*: C. Argente del Castillo Ocaña/J. Rodríguez Molina, Reglamentación de la vida de una ciudad en la edad media: Las ordenanzas de Baeza. *Cuadernos de Estudios Medievales y Ciencias y técnicas Historiográficas* 8–9, 1983, 5–108.
- Argente del Castillo Ocaña/Rodríguez Molina 1987*: C. Argente del Castillo Ocaña/J. Rodríguez Molina, La ciudad de Baeza a través de sus ordenanzas. *La España Medieval* 10, 1987, 323–342.
- Burgos Luengo 2001*: F. J. Burgos Luengo, El caso concreto de las Villas Romanas en una zona determinada: el Alto Guadalquivir. *Revista Digital Innovación y Experiencias Educativas* 41 (Granada 2001).
- Cantarero Quesada 2018*: J. M. Cantarero Quesada, De iglesias, ermitas y humilladeros. *Book of Semana Santa de Baños de la Encina* (Baños de la Encina 2018) 65–78.
- Cantarero Quesada 2006*: J. M. Cantarero Quesada, La torruca, eje cultural del territorio. *Arte, Arqueología e Historia* 13, 2006, 289–297.
- Cantarero Quesada 2016*: J. M. Cantarero Quesada, Territorio, turismo y senderos temáticos, el caso de Baños de la Encina, Jaén. In: F. Manero Miguel/J. L. García Cuesta (eds.), *Cultural Heritage and Territorial Development* (Cizur Menor 2016) 277–308.
- Cantarero Quesada 2019*: J. M. Cantarero Quesada, Camino del Santuario o de Majavieja, Baños de la Encina. Sobre las connotaciones simbólicas de su patrimonio. In: E. Escobedo Molinos/J. A. López Cordero/M. Cabrera Espinosa (eds.), *VII Congreso Virtual sobre Historia de las vías de comunicación*, September 15–30 (Jaén 2019) 73–96.
- Córcoles de la Vega 1992*: J. V. Córcoles de la Vega, Baños de la Encina. *Soproargra* (Jaén 1992).
- Cruz Cabrera 2008*: J. P. Cruz Cabrera, Los edificios del agua. *Arte, cultura e hidráulica en Baeza*. Ayuntamiento de Baeza and Instituto Geológico y Minero de España (San Fernando de Henares 2008).
- García García et al. 2011*: F. García García/J. M. Cantarero Quesada/V. Aranda Sanjuán/J. Calero/A. Céspedes, Los geosenderos periurbanos: el ejemplo pionero del Geosendero de La Pizarrilla (Baños de la Encina, Jaén). *Revista de la Asociación Española para la Enseñanza de las Ciencias de la Tierra* 19.1, 2011, 104–110.
- Gozalves Cravioto 2019*: C. Gozalves Cravioto, El patrimonio medieval y morisco de un pueblo de la Axarquía Malagueña: Canillas de Aceituno (Málaga 2019).
- Gutiérrez Calderón/Castillo Armenteros 2013*: M. V. Gutiérrez Calderón/J. C. Castillo Armenteros, El control del territorio en la comunidad de villa y tierras de Baeza (Jaén): apuntes desde la arqueología espacial. *Fortificações e território na Península Ibérica e no Magreb (séculos VI a XVI)* 1 (2013) 227–242.
- Moreno Onorato et al. 2008*: A. Moreno Onorato/F. Contreras Cortés/J. A. Cámara Serrano/L. Arboledas Martínez/E. Alarcón García/M. Sánchez Romero, Nuevas aportaciones al estudio del control del agua en la Edad del Bronce. La cisterna de Peñalosa (Baños de la Encina, Jaén). *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 18, 2008, 297–316.
- Moya García 2014*: S. Moya García, Actuación arqueológica puntual en el castillo de Burgalimar de Baños de la Encina (Jaén), 2007–2009. *Las Navas de Tolosa 1212–2012: miradas cruzadas* (Jaén 2014) 593–606.
- Muñoz-Cobo y Fresco 1988*: J. Muñoz-Cobo y Fresco, Baños de la Encina: un viaje a su historia milenaria (Jaén 1988).
- Ramos Vázquez 2003*: I. Ramos Vázquez, Memoria del Castillo de Baños de la Encina (Jaén 2003).
- Rodríguez Molina 1984*: J. Rodríguez Molina, El Alto Guadalquivir tierra vetada a los ganados trashumanes. *Estudios de historia y arqueología medievales* 15.3–4, 1984, 31–42.

- Rodríguez Molina 2015*: J. Rodríguez Molina, El Puerto del Muradal, permeabilidad entre Castilla-La Mancha y Andalucía. III Congreso Virtual sobre Historia de las Vías de Comunicación (Jaén 2015) 271–284.
- Roll Grande 2012/2013*: M. Roll Grande, Caminos y lugares de Sierra Morena en torno a la Batalla de las Navas de Tolosa. Alcazaba 12–13 (Jaén 2012/2013) 85–116.
- Rueda 1964*: F. Rueda, Sobre el origen de Baños, nuestro pueblo, y por qué se llama así. Book of Fiestas de Primavera de Baños de la Encina (Baños de la Encina 1964) 19–20.
- Torres Jiménez 2006*: J. C. Torres Jiménez, El Bandolerismo en el Reino de Jaén. Fundación para el Desarrollo de los Pueblos de la Ruta del Tempranillo (Lucena 2006).
- Villalobos Megía et al. 2006*: M. Villalobos Megía/A. B. Pérez Muñoz/J. C. Braga Alarcón, Geodiversidad y Patrimonio Geológico de Andalucía (Sevilla 2006).

Luis Benítez de Lugo Enrich and Miguel Mejías Moreno

Climatic Crisis, Socio-Cultural Dynamics and Landscape Monumentalisation during the Bronze Age of La Mancha

The Motilla Culture as an Adaptation to the Changes of the End of the 3rd mill. calBC

Keywords: prehistoric archaeology, climate change, western Mediterranean, South Iberian Plateau, Chalcolithic, resilience, groundwater

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Abstract

The Motilla Culture may be the oldest evidence for large-scale groundwater management in Europe. The archaeological and paleoenvironmental data suggest a close relationship between the location of the *motillas* and the geological landscape. *Motillas* were built during the 4.2 ka calBP climate event, at a time of environmental stress. This event has been related to the collapse of diverse civilisations around the world. In the Iberian Peninsula, it occurred at the transition between the Copper Age and Bronze Age in La Mancha. At that time, there also was a rapid

disappearance of peninsular men on the occasion of the arrival of settlers from the eastern steppes of Europe, carrying chromosome Y R1b (Olalde et al. 2019; Villalba-Mouco et al. 2021). One of them was buried in Tomb 4 of Castillejo del Bonete (Terrinches) with a woman genetically compatible with Iberian populations of the Copper Age. She lived and died in the centre of the Iberian Peninsula and, although she lacked ancestry of the steppes, she fed on protein from marine resources and wore clothes with ivory buttons. This sacred place of the culture of the *motillas* was conceived as a monumental and funerary place built in memory of the ancestors and in relation to the solar cycles of death and resurrection of the sun, being used for a millennium.

The construction of monumentalised wells of the Motilla Culture that reached the water table to access groundwater was a successful solution that lasted almost a millennium and was an important technological development that shaped the emergence of more complex and hierarchical societies in the region. At the moment, the existence of a monumental well has been verified by archaeological excavations in the *motilla* of El Azuer (Daimiel). Five other wells have been detected by geophysical surveys in each and every one of the *motillas* studied in this way: those of Vega and El Cura (Daimiel), El Acequión (Albacete), Santa María, and El Retamar (Argamasilla de Alba).

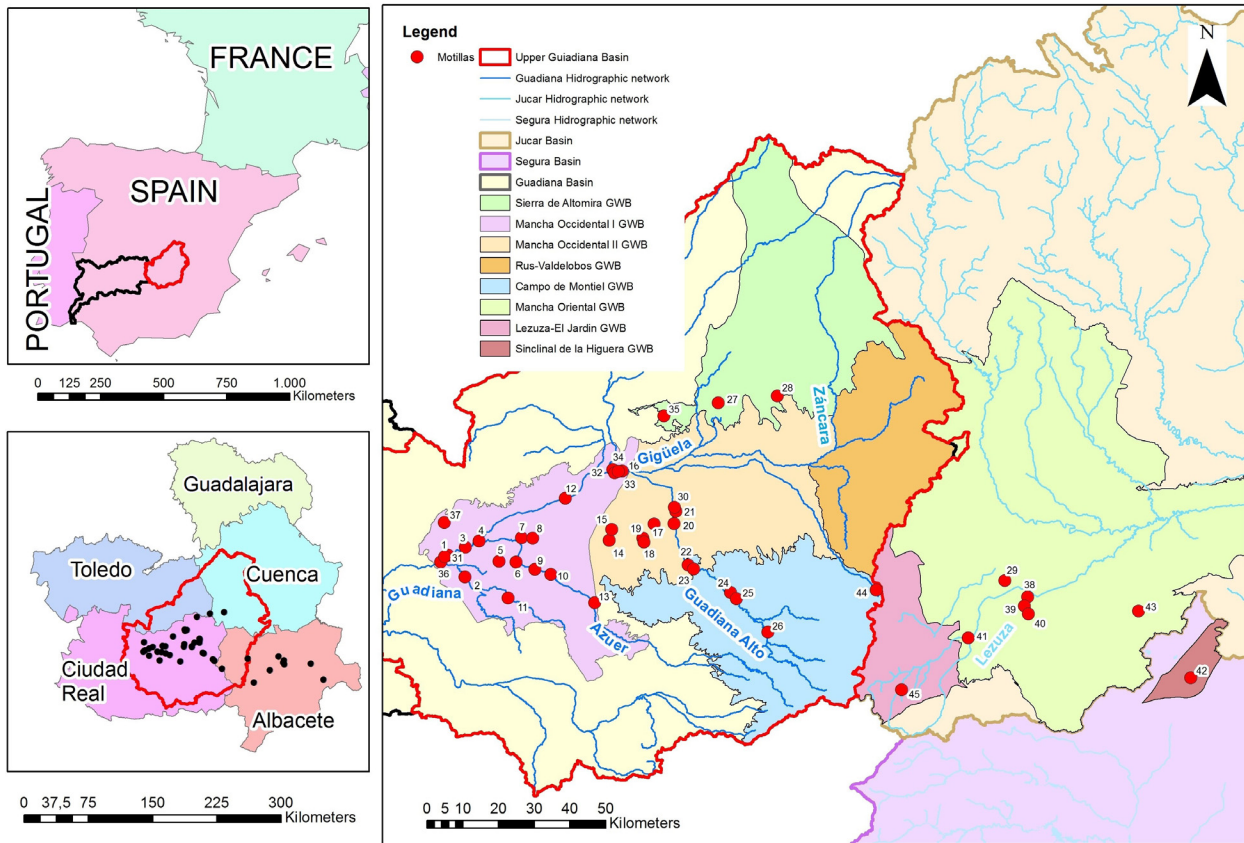


Fig. 1. Major river system in the plain of La Mancha and location of *motillas*. Distribution of the *motillas*: 1. El Quintillo, 2. Torralba, 3. El Cura, 4. Las Cañas, 5. La Albuera, 6. Daimiel, 7. La Máquina, 8. Zuacorta, 9. La Vega Media, 10. El Azuer, 11. Los Palacios, 12. La Vega, 13. El Espino, 14. Pedro Alonso, 15. Los Romeros, 16. Brocheros, 17. Casa de Mancha, 18. Barrios, 19. Perales, 20. La Membrilleja, 21. El Juez, 22. Santa María, 23. El Retamar, 24. La Moraleja, 25. Laguna de Cueva Morenilla, 26. La Jacidra, 27. El Morrión, 28. El Pedernoso, 29. El Acequión, 30. El Cuervo, 31. Malvecinos, 32. Pedregosas, 33. Camino de Herradero I, 34. Camino de Herradero II, 35. Huerta de Triviño, 36. Antonino, 37. Malagón, 38. Ojo de San Jorge, 39. Hoya Vacas, 40. Gorrineras, 41. Balazote, 42. Hoya Rasa, 43. Prado Viejo, 44. Chavillo, 45. Arquillo.

The Bronze Age Motilla Culture of La Mancha modelled the landscape and constitutes a unique adaptation of the inhabitants of the territory to this situation of climatic and social change.

Introduction

Motillas are a type of archaeological site only present in the region of La Mancha (Spain). La Mancha region is in the interior of Spain, in the southern part of the Spanish Meseta, also known as the Central Plateau. 45 *motillas* are known to date. *Motillas* represent locations where wells have been found, representing the oldest-known systems in Europe that were constructed to tap groundwater. The first inventory of the *motillas*

was presented in 2010 and its update has been published in 2020. This is an investigation that has not been closed yet (Benítez de Lugo Enrich 2011; Benítez de Lugo Enrich et al. 2020) (fig. 1).

The *motillas* were built during the climatic event known as the 4.2 ka calBP climate event, in a time of environmental stress after a period of severe and prolonged world-scale megadrought, detected by many researchers in different parts of the planet (Arz et al. 2006; Bar-Mathews et al. 1997; Berglund 2001; 2003; Blanco González et al. 2018; Bond et al. 1997; Booth et al. 2005; Clare/Weninger 2010; Courty 1998; Cullen et al. 2000; Davis/Thompson 2006; Delibes et al. 2015; Drysdale et al. 2005; Fábregas et al. 2003; Fagan 2007; Gao et al. 2007; Gasse/van Campo 1994; Gibbons 1993; Huang et al. 2011; Kerr 1998; Lillios et al.

2016; Magny et al. 2009; Mayewski et al. 2004; Menotti 1999; Menounos et al. 2008; O'Brien et al. 1995; Parker et al. 2006; Peiser 1998; Roland et al. 2014; Stanley et al. 2003; Staubwasser et al. 2003; Thompson et al. 2002; Weiss et al. 1993; Wilkinson 1997; Wu/Liu 2004). For many years, it was assumed that the *motillas* had been surrounded by water at the time when they were in use, and that they were fortified villages where people from similar social classes used to live and control the strategic resources, such as cereals and water. In previous research, it has been argued that the *motillas* were built in a dry environment in order to find groundwater at a time of arid climate, when surface water had dried up. The aridity was progressive, although intermittently, as the pollen sequences of Castillejo del Bonete and the *motilla* of El Azuer have revealed (Benítez de Lugo Enrich et al. 2015; 2020; Mejías Moreno et al. 2020). These studies indicate a sharp drop in temperatures and an increase in annual rainfall around 1600 calBC. This change caused the recovery of the riverside forests, but also the fluvial floods, which had to flood the buildings located in the surroundings of the *motillas* and began to seriously endanger their habitability, as they were located in the middle of the river beds that progressively flowed again. The Chalcolithic communities that inhabited La Mancha suffered an environmental crisis due to water stress that led them to reorganise their settlements and water catchment systems. Water is a critical resource for human beings, and Bronze Age communities in La Mancha must have developed mechanisms to cope with its scarcity. At the end of the 3rd mill. calBC, they began to build the first European system of exploitation of an aquifer on a regional scale.

This work delves into this idea, which was previously presented through the study of a case: the *motilla* of El Retamar (Benítez de Lugo Enrich/Mejías Moreno 2014; 2015; 2016; 2017; 2020; Mejías Moreno et al. 2014; 2015; 2020).

Until geophysical surveys are developed and published – which verify the probable existence of a large clogged well inside this *motilla* – this study presents the results of the hydrogeological analysis aimed at assessing the possibility of accessing underground stable fresh water at this site at the beginning of the Bronze Age.



Fig. 2. Motilla del Azuer (Damiel) (Air Works Service, Geological Survey of Spain).

Archaeological Background

Some paleopalynological studies in areas of the Central Plateau of the Iberian Peninsula indicate that there was an especially prolonged dry and arid period in the second half of the 3rd mill. calBC (Benítez de Lugo Enrich et al. 2015; López-Sáez et al. 2014a; 2014b; 2015). In this context, wells reaching the phreatic level have been detected inside *motillas*, both through archaeological excavations in El Azuer (Aranda et al. 2008) and by geophysical prospecting in the *motillas* of El Acequión (Albacete), El Retamar and Santa María (Argamasilla de Alba, Ciudad Real), El Cura and La Vega (Daimiel, Ciudad Real) (Ibarra 2015; Teixidó et al. 2013). The *motilla* of El Azuer (Daimiel, Ciudad Real) is the most thoroughly studied from an archaeological point of view, although its relationship to the local hydrogeology was not considered in depth until the recent years (Mejías Moreno et al. 2014). It has been established that it was occupied for almost a millennium. The well of the *motilla* reaches the limestones of the Pliocene regional aquifer, located at about 20m deep (fig. 2).

Motillas are not the only kind of sites in the Bronze Age of La Mancha. There also exist settlements in height, sacred places monumentalised by burial mounds, burial caves, small villages in the plain and fields of silos dug in dry places, which were used to store food. All of them have their roots in Chalcolithic times, in a tradition in which continuity is observed from the middle of the 3rd to the beginning of the second half of the

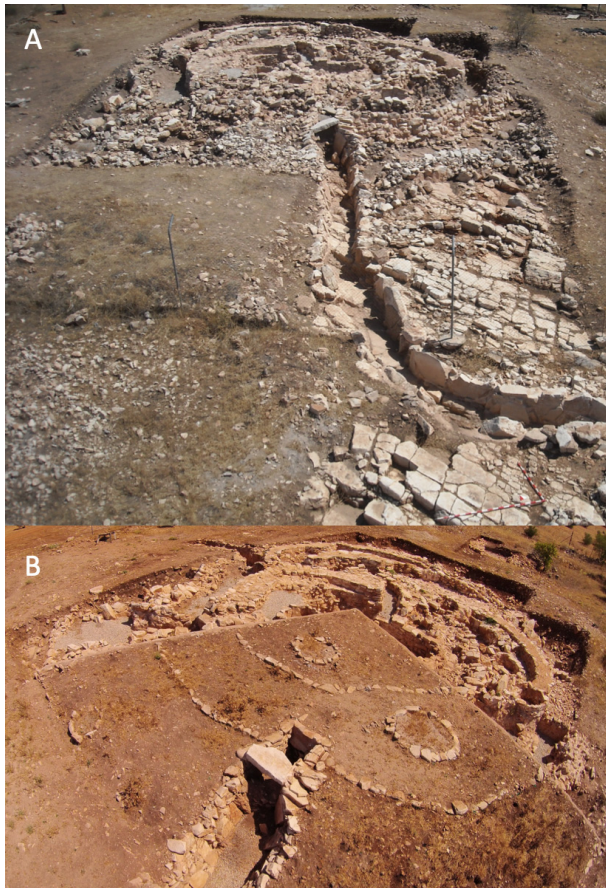


Fig. 3. Castillejo del Bonete (Terrinches, Ciudad Real): A. Great Tumulus 1 (at the back of the image) once excavated, Corridor 1, more than 20m long; B. Great Tumulus 1 after the restitution of $\frac{1}{4}$ part of its surface to show its original shape.

2nd mill. calBC. For the sake of brevity of this article, it is not possible to delve into this question, which has been already dealt with in previous papers.

The beginning of the Bronze Age in La Mancha coincides with that abrupt climate event characterised by extreme aridity known as the 4.2 ka calBP climate event, dated to occur between 2350 and 1850 calBC, approximately. This climatic event was considered one of the most severe aridification events of the Holocene period in the Iberian Peninsula, and it seems likely that the impetus for the construction of *motillas* was this period of severe drought and aridity. For the inhabitants of *motillas*, the pernicious consequences of the climatic transformations could be aggravated by economic practices that, in the medium and long term, contributed to the disappearance of fertile soils, due to the proliferation of cereal crops highly demanding in nitrogen, such as dragging of the

humus through erosive processes associated with few moments of torrential rains on a sparse vegetation cover. Massive deforestation of anthropic origin and high levels of grazing could further activate the tendency to aridity that climate change itself caused (Escacena Carrasco 2018). This is further supported by the fact that the abandonment of these sites coincides – around 1400 calBC – with the period when the climate returned to more humid and warmer conditions, after some time of suffering the increasingly frequent floods.

In recent years, these *motillas* have been associated to ceremonial places located in strategic sites of great visibility and territorial control. These enclaves were monumentalised by large burial mounds, in which solar rituals related to the death/resurrection cycle of the sun and the ancestors are detected. The archaeological site of Castillejo del Bonete (Terrinches, Ciudad Real) is one of these ceremonial sites (*fig. 3*). It is made up of burial mounds, the largest of which was built over a natural cave which contains stone structures and rock art. The mounds are connected by corridors, some of them with astronomical orientations to the winter solstice. Corridor 1 is over 20m long. These sacred monuments share some features with the *motillas*, as it is explained in previous works (Benítez de Lugo Enrich/Esteban 2018; Benítez de Lugo Enrich 2018; Benítez de Lugo Enrich et al. 2020).

At present, archaeological excavations are only being carried out in the *motilla* of El Retamar (Argamasilla de Alba, Ciudad Real), in a project involving the Geological Survey of Spain and promoted by the City Council of Argamasilla de Alba, the Regional Government of Castilla-La Mancha and the E2IN2 company. The project was funded with 25,700€ in 2019 and 23,982€ in 2021, and is entitled: ‘Climate and social change in La Mancha at the end of the third millennium cal. BC: research in motilla de El Retamar (Argamasilla de Alba, Ciudad Real)’ (*fig. 3*). The first phase of the archaeological excavations in this *motilla* took place between 1984 and 1991 and made it possible to detect a central tower surrounded by two walls and a wide space at the foot of the tower, in which a well similar to the one documented in the *motilla* of El Azuer was drilled. Characteristic objects of the Bronze Age of La Mancha were documented in

the site, as well as diverse burials. An Argaric halberd was found during the 2019 research (Benítez de Lugo Enrich 2022). Two radiocarbon analyses on charcoal remains were performed during those archaeological research campaigns, providing this data: 3585 ± 55 BP (CSIC-796) and 3520 ± 55 BP (CSIC-797) (Idearq 2020). At that time, the well inside the *motilla* was probably clogged; the cause that had motivated its opening had disappeared, because the 4.2 ka calBP climate event had ended. Its fresh water from the aquifer mixed with the muddy and dirty water from the river becoming useless. The walls (dikes) built to prevent it could do nothing to avoid it, turning the well into a useless infrastructure. At that time, with the springs and surface waters running again, life in the *motilla* still persisted, but it was approaching its last moments, suffering in the middle of the Guadiana riverbed the onslaught of floods, more and more recurrent. The hypothesis is that this pattern was common and recurrent in the Motilla Culture. This study represents an advance to investigate it.

Methods

The geological and lithological characteristics of the study area have been obtained from geological maps at a scale of 1:50,000 of the Geological Survey of Spain (IGME) Magna series, which includes the whole territory of Spain. The climatological data comes from the State Meteorological Agency, and corresponds to the daily precipitation data from 1960 to 2019, completed by using regression methods and statistical analysis in spreadsheets. The data of the hydrogeological infrastructure came from the IGME Database Aguas XXI and the Database of the Official Groundwater Control Network of the Guadiana River Hydrographic Demarcation. Finally, the hydrogeological characteristics of the surroundings of the El Retamar *motilla* were summarised from the river basin management plan.

Results and Discussion

The *motilla* of El Retamar is located in the municipality of Argamasilla de Alba (Ciudad Real), on the flood plain of the Upper Guadiana River, on the



Fig. 4. Motilla de El Retamar (Argamasilla de Alba, Ciudad Real).

left bank of the channel through which the river currently flows, and on Quaternary deposits at the bottom of the valley. From a hydrogeological point of view, it is in the groundwater body (GWB) 041.010, Campo de Montiel, in the upper basin of the Guadiana River. The GWB basement is made up of a base of quartzite and ordovician shales. In angular discordance, the Triassic is superimposed, which outcrops to the south and west of the GWB, and consists of red and green gypsiferous marls and clays in Keuper facies, which constitutes the low-permeability substrate. The regional aquifer is made up of limestone and dolomites from the Lower Lías (Jurassic), which have high permeability due to fractures and dissolution, with higher transmissivity in the central zone, upstream and around the Lagunas de Ruidera. Relatively less permeable are the oolitic limestones of the upper Lías that extend into the eastern zone of the aquifer, and which present the highest values of transmissivity to the southeast of the Campo de Montiel. There also are small hanging aquifers, of lower permeability, formed by the limestones and calcareous breccias of the Upper Tertiary, which emerge in the central-western part of the aquifer, and by the Plio-Quaternary deposits. Fig. 5 shows the position of two geological profiles (A–A' and B–B'), whose point of intersection is very close to the *motilla* of El Retamar (fig. 4). Fig. 6 and 7 represent the geological sections, in which the lithostratigraphic distribution can be seen vertically.

The Geological Survey of Spain carries out a systematic analysis of monthly rainfall at several

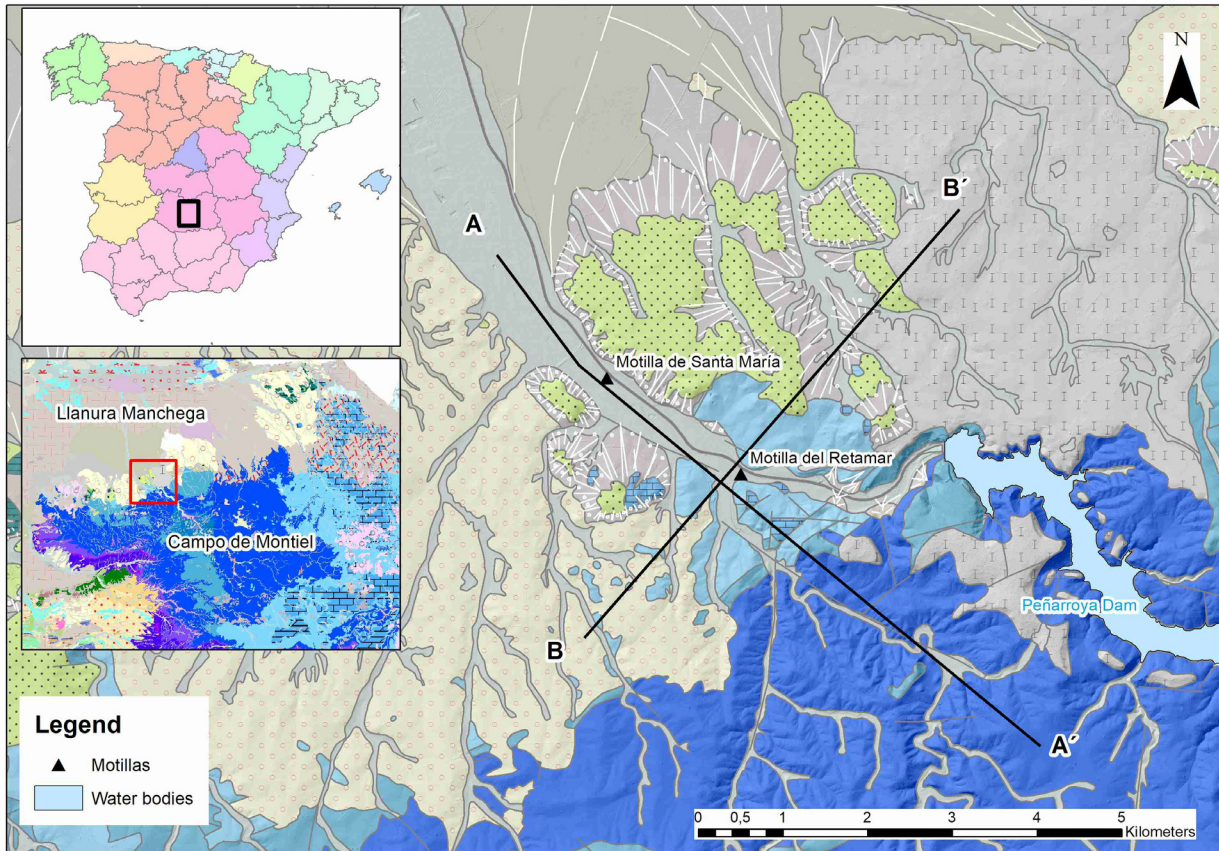


Fig. 5. Location of the geological profiles A-A' and B-B' near the motilla of El Retamar.

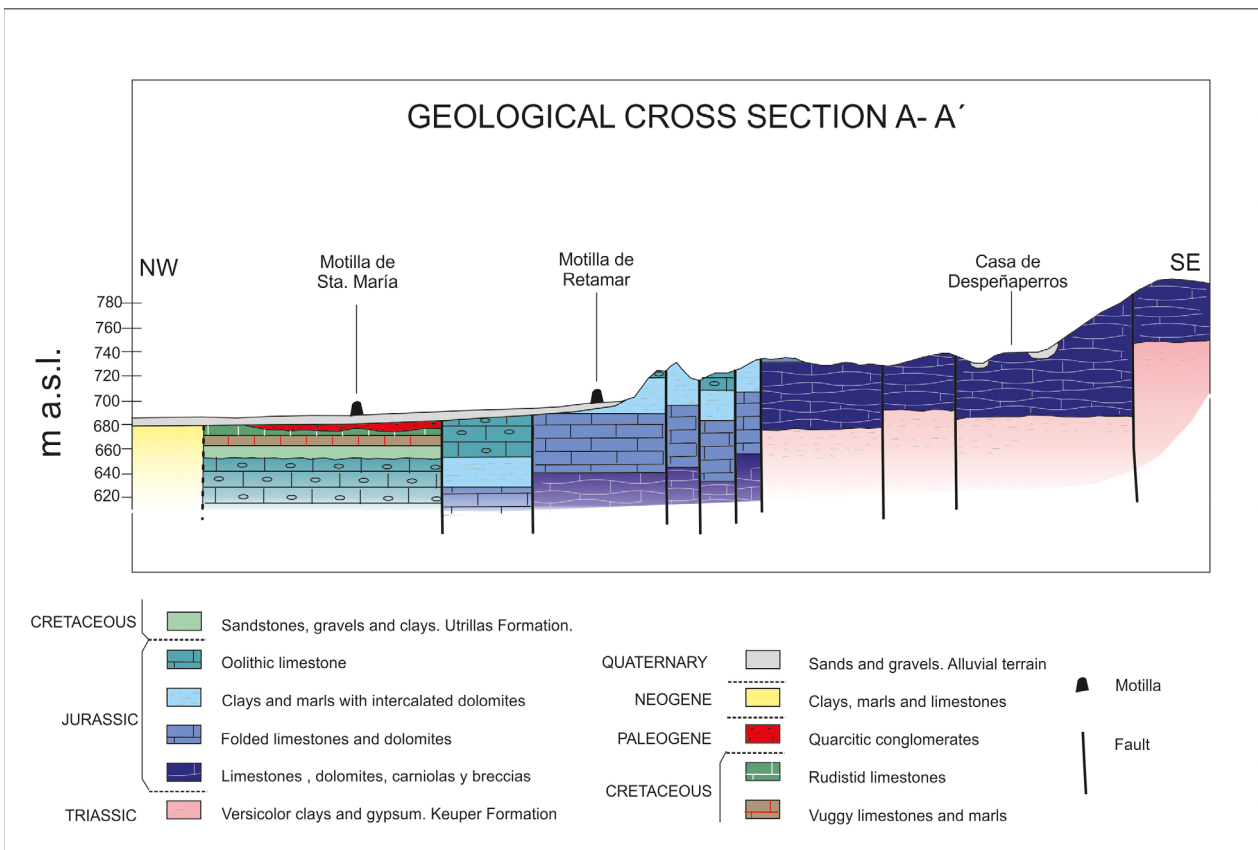


Fig. 6. Geological profile A-A'.

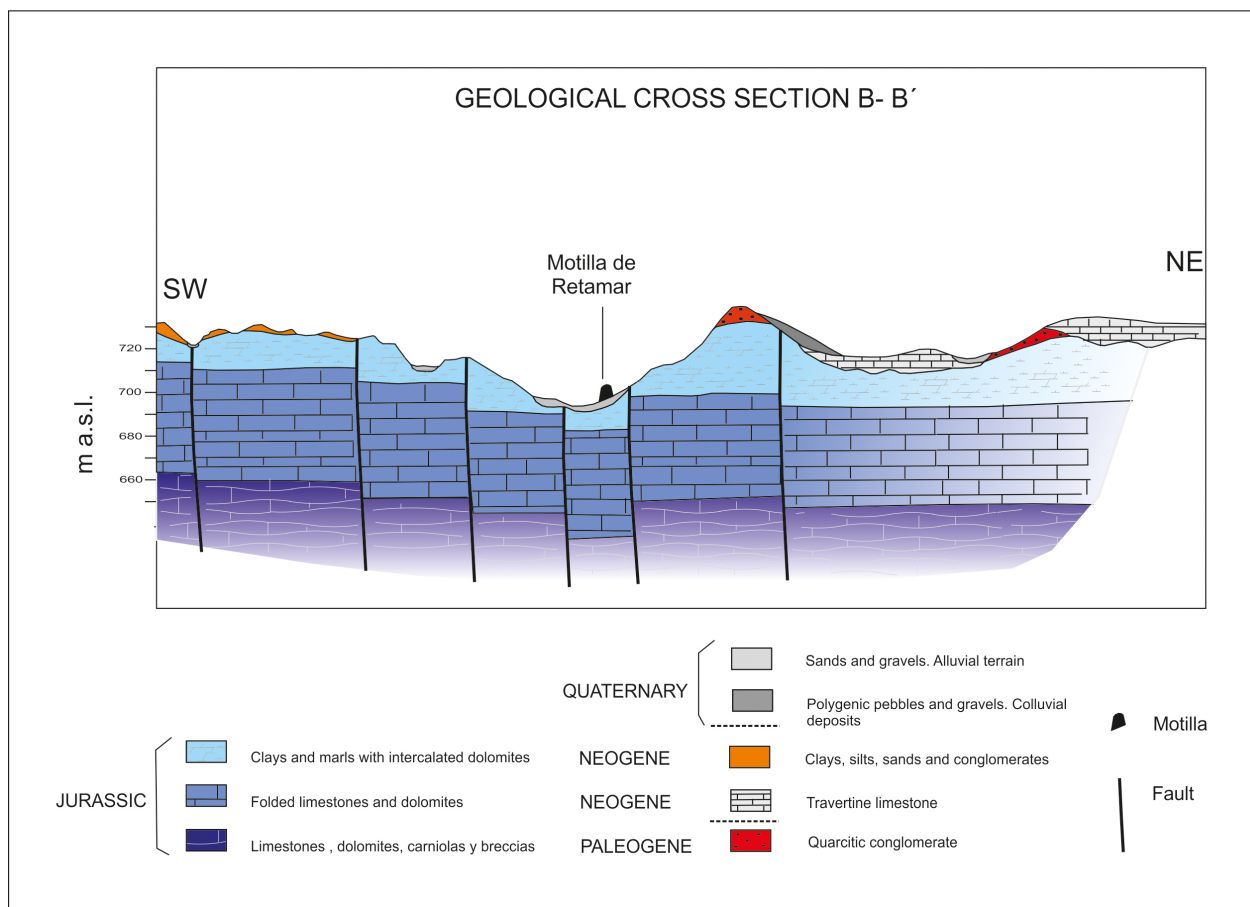


Fig. 7. Geological profile B-B'.

thermo-pluviometric stations that have updated records in the upper Guadiana basin. The period of data analysed starts from the hydrological year 1960/1961 to 2018/2019, reaching a total of 59 years with records, from which the historical pluviometric series is configured. For GWB Campo de Montiel, historical data from five stations are available: Carrizosa, Villanueva de la Fuente, La Solana (institute), Ruidera and Ossa de Montiel. The available precipitation values reach at least until 2019 in all the mentioned stations. The two thermo-pluviometric stations (with historical series) closest to El Retamar are: 4007-B Ossa de Montiel and 4012 Ruidera. The annual precipitation presents an average value of 515.1mm, and the minimum and maximum annual values are 232.5mm in the year 2004/2005 and 938.5mm in the year 2012/2013, respectively. The climatic sequence of the last six years could be classified as average, in contrast to the great majority of the stations of the upper Guadiana basin in which the last six years constitute a dry cycle interrupted

punctually by the wet year 2017/2018. The annual precipitation values in Campo de Montiel, for the historical series from 1960 to 2019, show an average value of about 500mm.

The piezometric evolution of the aquifer of Campo de Montiel, the GWB of Campo de Montiel, is characterised by being a free karstic aquifer and the groundwater flow is very conditioned by the presence of fractures and/or karstification and their direction. The storage capacity is scarce and suffers important piezometric oscillations linked to precipitation events. Consequently, it is an aquifer with low water regulation capacity. Rain is the main source of recharge of the GWB, and visible discharge occurs through the springs and, mainly, towards Las Lagunas de Ruidera, as well as by underground transfer towards the northward GWB. The March 2019 isopieze reflects a flow direction of groundwater from south to north, in the northern two thirds of the mass surface. This direction of flow has not been significantly altered in recent decades

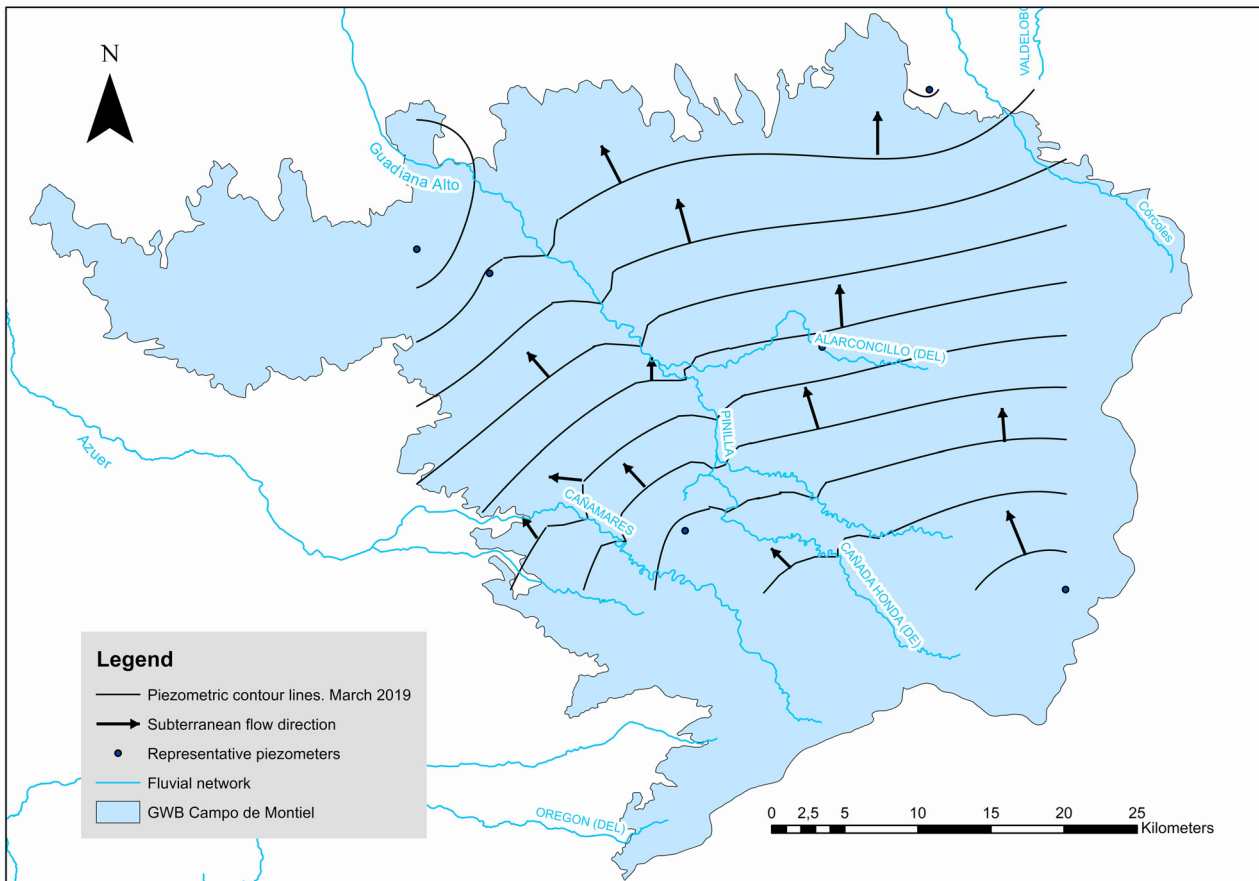


Fig. 8. Piezometric lines corresponding to the high-water period of 2019.

and is considered similar to that established for the natural regime of Campo de Montiel GWB. In the isopieces of fig. 8, the inflections typical of piezometry have been inferred towards the rivers and streams that cross the mass, since these constitute preferential points of discharge of the aquifer in favour of numerous springs. As already mentioned, the piezometric levels of the GWB Campo de Montiel fluctuate according to the succession of wet and dry periods, with rapid rises immediately after rainfall and equally intense falls shortly afterwards. The direction of the underground flow remains unchanged, from south to north, despite these alterations (fig. 8). From the point of view of its hydrological behaviour, the Campo de Montiel aquifer has not suffered drastic alterations with respect to its functioning in a natural regime, including pre-historic times. The oscillations of the piezometric levels are due more to the rainfall sequences than to the water extractions from the aquifer. The water table of the Mesozoic aquifer is located in an

interval between 680–700m a.s.l., and the alluvial of the Guadiana river behaves, most of the time, as a hanging aquifer with a water table above the piezometric level of the Mesozoic aquifer, although in situations of maximum height of this level, it would recharge the alluvial aquifer.

Conclusions

The inhabitants of the *motilla* of El Retamar may have had to rely for their water supply at moments of severe drought – due to the decrease in rainfall derived from the 4.2 ka calBP climate event (López-Sáez et al. 2015) – on the regional aquifer. Due to the absence of regular water flow by the Guadiana river and considering that the piezometric level of the Mesozoic aquifer, given the scarcity of rainfall, could be found in the lower third of the interval of fluctuation, as determined for the *motilla* of El Azuer (Benítez de Lugo Enrich/Mejías Moreno 2017; 2016; Mejías Moreno et al. 2014), by

drilling a relatively shallow well – around 4–15m from the surface – it would be possible to capture the groundwater existing in the alluvial of the Guadiana. A well of the mentioned depth (4–15m) would be viable to build with the technology of the time, as has been demonstrated by the dimensions of the well found in the *motilla* of El Azuer. In a prolonged situation of scarce rainfall, it would be nil or very scarce to obtaining groundwater from the alluvial levels of conglomerates, sand and silt. The safest and most stable water supply would be from the upper part of the limestones on the roof of the Mesozoic series, but the piezometric level would be too deep for reaching with a well built with the possibilities of the Bronze Age.

The geophysical and hydrogeological studies that are being developed agree that the big well documented in the *motilla* of El Azuer is no exception. The reason for building the *motillas* could be related to the exploitation of the aquifer at the regional level. How this water management influenced Bronze Age society is something that has yet to be studied and debated. Regional livestock – mainly sheep and goats – necessarily had to have a close relationship with the *motillas*, which became places of provisioning in natural communication routes and throughout the dry La Mancha plain. In summary, it has been found that the Motilla Culture might be the oldest evidence for large-scale water management in Europe, in relation to a water supply of people and livestock.

Motillas were built during the 4.2 ka calBP climate event, at a time of environmental stress. This event has been related to the collapse of diverse civilisations around the world. In the Iberian Peninsula, it occurred in the transition between the Copper Age and Bronze Age in La Mancha. The archaeological and paleoenvironmental data suggest a close relationship between the location of the *motillas* and the hydrogeological landscape. The timing of the 4.2 ka calBP climate event and the arrival of people with steppic ancestry coincides with the construction of the La Mancha *motillas*. For this reason, it seems reasonable to presume a relationship between all these events, although the precise nature of this relationship needs to be further investigated. The arrival of eastern Europeans, whose males could have completely replaced the males of the Iberian Peninsula

in a short period of time between the Chalcolithic and the beginning of the Bronze Age, is a recently known historical fact that must be explained and embedded into this process in the future.

The construction of monumentalised wells that reached the local water table to access groundwater was a successful solution that lasted almost a millennium and was an important technological development that shaped the emergence of more complex and hierarchical societies in the region. Similarly, the end of the climatic event, when wetter conditions developed, coincides with the abandonment of *motillas*. The increase in precipitation and the progressive elevation of the phreatic level after 1800 calBC would have allowed for the recovery of rivers and humid zones that had nearly disappeared between 2000–1800 calBC, to point that some *motillas* could have been flooded, as this has been shown by archaeological records in the *motilla* of El Retamar.

From that moment on, after abandoning the *motillas*, the people of La Mancha redefined their relationship with the environment. At the end of the Bronze Age, they were involved in new forms of social and economic organisation and new models of settlement away from the wetter environments where *motillas* used to be.

The Bronze Age Motilla Culture of La Mancha modelled the landscape; it constitutes a unique adaptation of the inhabitants of the territory in a climate crisis situation and can be considered as the first hydraulic culture of Europe.

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Bibliography

- Aranda et al. 2008*: G. Aranda/S. Fernández/M. Haro/F. Molina/T. Nájera/M. Sánchez-Romero, Water Control and Cereal Management on the Bronze Age Iberian Peninsula. La motilla del Azuer. *Oxford Journal of Archaeology* 27.3, 2008, 241–259.
- Arz et al. 2006*: H. W. Arz/F. Lamy/J. Patzold, A Pronounced Dry Event Recorded around 4.2 ka in Brine Sediments from the Northern Red Sea. *Quaternary Research* 66.3, 2006, 432–441.
- Bar-Matthews et al. 1997*: M. Bar-Matthews/A. Ayalon/A. Kaufman, Late Quaternary Paleoclimate in the Eastern Mediterranean Region from Stable Isotope Analysis of Speleothems at Soreq Cave, Israel. *Quaternary Research* 47.2, 1997, 155–168.
- Benítez de Lugo Enrich 2011*: L. Benítez de Lugo Enrich, Las motillas del Bronce de La Mancha. Treinta años de investigación arqueológica. In: P. Bueno/A. Gilman/C. Martín Morales/J. Sánchez-Palencia (eds.), *Arqueología, sociedad, territorio y paisaje. Estudios sobre Prehistoria Reciente, Protohistoria y transición al mundo romano en homenaje a M^a Dolores Fernández Posse*. *Bibliotheca Praehistorica Hispana* 28 (Madrid 2011) 141–162.
- Benítez de Lugo Enrich 2018*: L. Benítez de Lugo Enrich, Rituales funerarios neolíticos, calcolíticos y de la Edad del Bronce en la provincia de Ciudad Real. Cerro Ortega (Villanueva de la Fuente) y Castillejo del Bonete (Terrinches). *Anejos Cuadernos de Prehistoria y Arqueología de la Universidad Autónoma de Madrid* 3, 2018, 153–168.
- Benítez de Lugo Enrich/Esteban 2018*: L. Benítez de Lugo Enrich/C. Esteban, Arquitecturas simbólicas orientadas astronómicamente durante el Neolítico final, Calcolítico y la Edad del Bronce en el sur de la Meseta. *Spal. Revista de Prehistoria y Arqueología* 27.1, 2018, 61–87.
- Benítez de Lugo Enrich/Mejías Moreno 2014*: L. Benítez de Lugo Enrich/M. Mejías Moreno, Los primeros poblados prehistóricos en el entorno de Daimiel. Las motillas de la Mancha. In: M. Mejías (ed.), *Las Tablas y los Ojos del Guadiana. Agua, paisaje y gente* (Madrid 2014) 65–104.
- Benítez de Lugo Enrich/Mejías Moreno 2015*: L. Benítez de Lugo Enrich/M. Mejías Moreno, La prehistórica Cultura de las Motillas. Nuevas propuestas para un viejo problema. *Veleia* 32, 2015, 111–124.
- Benítez de Lugo Enrich/Mejías Moreno 2016*: L. Benítez de Lugo Enrich/M. Mejías Moreno, Hidrogeología y captación de aguas subterráneas en La Mancha durante la Prehistoria reciente. La gestión de los recursos hídricos en la Cultura de las Motillas. *Archivo de Prehistoria Levantina* 31, 2016, 137–168.
- Benítez de Lugo Enrich/Mejías Moreno 2017*: L. Benítez de Lugo Enrich/M. Mejías Moreno, The Hydrogeological and Paleoclimatic Factors in the Bronze Age Motillas Culture of La Mancha (Spain). The First Hydraulic Culture in Europe. *Hydrogeology Journal* 25.7, 2017, 1931–1950.
- Benítez de Lugo Enrich et al. 2015*: L. Benítez de Lugo Enrich/N. Palomares Zumajo/H. J. Álvarez García/R. Barroso Bermejo/M. Benito Sánchez/H.-A. Blain/P. Bueno Ramírez/R. De Balbín Behrmann/S. Fernández Martín/J. A. López-Sáez/M. A. Galindo Pellicena/M. A. Garrido Martínez/C. Laplana Conesa/E. Mata Trujillo/G. Menchén Herreros/I. Montero Ruiz/J. Moraleda Sierra/A. Morgado Rodríguez/C. Odriozola Lloret/E. Polo Martín/M. Ruiz-Alonso/P. Sevilla García/T. X. Schuhmacher/D. C. Salazar-García, Paleoecología y cultura material en el complejo tumular prehistórico de Castillejo del Bonete (Terrinches, Ciudad Real). *Menga. Revista de Prehistoria de Andalucía* 6, 2015, 112–140.
- Benítez de Lugo Enrich et al. 2020a*: L. Benítez de Lugo Enrich/M. Mejías Moreno/J. A. López-Sáez/C. Esteban, The Origins of Social Inequality in Prehistoric Europe. Rituals and Monuments to Control Wealth in the Bronze Age of La Mancha. In: K. Lillios/P. Díaz del Río (eds.), *Political Matters in Prehistory. Papers in Honor of Antonio Gilman Guillén*. *Bibliotheca Praehistorica Hispana* 35 (Madrid 2020) 249–260.

- Benítez de Lugo Enrich et al. 2020b*: L. Benítez de Lugo Enrich/M. A. Galindo Pellicena/C. Laplana Conesa/N. Palomares Zumajo/J. L. Fuentes Sánchez/A. Pérez Romero/D. C. Salazar García, Fauna e industria en materia dura de origen animal del lugar sagrado de la Cultura de las Motillas. Castillejo del Bonete (Terrinches, Ciudad Real). Cuadernos de Prehistoria y Arqueología de la Universidad Autónoma de Madrid 46, 2020, 45–77.
- Benítez de Lugo Enrich et al. 2022*: L. Benítez de Lugo Enrich/G. Aranda Jiménez/C. Gutiérrez Sáez/J. L. Fuentes Sánchez/A. M. Herranz Redondo/G. Menchén Herreros/I. Montero Ruiz/P. Muñoz Moro/L. Peña Chocarro/L. E. Vera Castellanos/A. Mederos Martín, Una alabarda argárica en la motilla de El Retamar (Argamasilla de Alba, Ciudad Real). Contexto, datación, procedencia e interpretación. Complutum 33.1, 2022.
- Berglund 2001*: B. E. Berglund, Cultural Landscapes in NW Europe. Is there a Link to Climate Changes? Terra Nostra 2001.3, 2001, 68–75.
- Berglund 2003*: B. E. Berglund, Human Impact and Climate Changes. Synchronous Events and a Causal Link? Quaternary International 105, 2003, 7–12.
- Blanco González et al. 2018*: A. Blanco González/K. Lillios/J. A. López-Sáez/B. L. Drake, Cultural, Demographic and Environmental Dynamics of the Copper and Early Bronze Age in Iberia (3300–1500 BC). Towards an Interregional Multiproxy Comparison at the Time of the 4.2 ky BP Event. Journal of World Prehistory 31, 2018, 1–79.
- Bond et al. 1997*: G. Bond/W. Showers/M. Cheseby/R. Lotti/P. Almasi/P. Demenecoal/P. Priore/H. Cullen/I. Hajdas/G. Bonani, A Pervasive Millennial-Scale Cycle in North Atlantic Holocene and Glacial Climates. Science 278, 1997, 1257–1266.
- Booth et al. 2005*: R. K. Booth/S. Jackson/S. L. Forman/J. E. Kutzbach/E. A. Bettis/J. Kreigs/D. K. Wright, A Severe Centennial-Scale Drought in Midcontinental North America 4200 Years Ago and Apparent Global Linkages. The Holocene 15.3, 2005, 321–328.
- Clare/Weninger 2010*: L. Clare/B. Weninger, Social and Biophysical Vulnerability of Prehistoric Societies to Rapid Climate Change. Documenta Praehistorica 37, 2010, 283–292.
- Courty 1998*: M. A. Courty, The Soil Record of an Exceptional Event at 4000 B.P. in the Middle East. British Archaeological Reports. International Series 728, 1998, 93–108.
- Cullen et al. 2000*: H. M. Cullen/P. B. De Menocal/S. Hemming/G. Hemming/F. H. Brown/T. Guilderson/F. Sirocko, Climate Change and the Collapse of the Akkadian Empire. Evidence from the Deep Sea. Geology 28, 2000, 379–382.
- Davis/Thompson 2006*: M. E. Davis/L. G. Thompson, An Andean Ice-Core Record of a Middle Holocene Mega-Drought in North Africa and Asia. Annals of Glaciology 43, 2006, 34–41.
- Delibes et al. 2015*: G. Delibes/F. J. Abarquero/M. Crespo/M. García/E. Guerra/J. A. López-Sáez/S. Pérez-Díaz/J. A. Rodríguez, The Archaeological and Palynological Record of the Northern Plateau of Spain during the Second Half of the 3rd Millennium BC. In: H. Meller/A. Wolfgang/R. Jung/R. Risch (eds.), 2200 BC. Ein Klimasturz als Ursache für den Zerfall der Alten Welt? 7. Mitteldeutscher Archäologentag vom 23. bis 26. Oktober 2014 in Halle (Saale). Tagungen des Landesmuseums für Vorgeschichte Halle 12 (Halle 2015) 429–448.
- Drysdale et al. 2005*: R. Drysdale/G. Zanchetta/J. Hellstrom/R. Maas/A. Fallick/M. Pickett/I. Cartwright/L. Piccini, Late Holocene Drought Responsible for the Collapse of Old World Civilizations is Recorded in an Italian Cave Flowstone. Geology 34.2, 2005, 101–104.
- Escacena Carrasco 2018*: J. L. Escacena Carrasco, Ad petendam pluviam. El petroglifo de Los Aulagares como respuesta religiosa al evento climático 4.2 ka cal. BP. Ilu. Revista de Ciencias de las Religiones 23, 2018, 81–110.

- Fábregas et al. 2003*: R. Fábregas/A. Martínez/R. Blanco/W. Chesworth, Environmental Change and Social Dynamics in the Second–Third Millennium BC in NW Iberia. *Journal of Archaeological Science* 30.7, 2003, 859–871.
- Fagan 2007*: B. Fagan, El largo verano. De la Era Glacial a nuestros días (Barcelona 2007).
- Gao et al. 2007*: H. Gao/C. Zhu/X. Weifeng, Environmental Change and Cultural Response around 4200 cal. yr BP in the Yishu River Basin, Shandong. *Journal of Geographical Sciences* 17.3, 2007, 285–292.
- Gasse/van Campo 1994*: F. Gasse/E. van Campo, Abrupt Post-Glacial Climate Events in West Asia and North Africa Monsoon Domains. *Earth and Planetary Science Letters* 126.4, 1994, 435–456.
- Gibbons 1993*: A. Gibbons, How the Akkadian Empire was Hung Out to Dry. *Science* 261, 1993, 985–998.
- Huang et al. 2011*: C. C. Huang/J. Pang/X. Zha/H. Su/Y. Jia, Extraordinary Floods Related to the Climatic Event at 4200 a BP on the Qishuihe River, Middle Reaches of the Yellow River, China. *Quaternary Science Reviews* 30.3–4, 2011, 460–468.
- Ibarra 2015*: P. Ibarra, Prospección geofísica aplicada al estudio de las motillas de la Edad del Bronce de La Mancha. In: M. Mejías/L. Benítez de Lugo Enrich/J. A. López-Sáez/C. Esteban (eds.), *Arqueología, hidrogeología y medio ambiente en la Edad del Bronce de La Mancha*. La Cultura de las Motillas (Madrid 2015) 45–50.
- Idearq 2020*: IDEArq. Infraestructura de Datos Espaciales de Investigación Arqueológica (Madrid 2020), <<http://www.idearqueologia.org>> (last access 05.10.2020).
- Kerr 1998*: R. A. Kerr, Sea-Floor Dust Shows Drought Felled Akkadian Empire. *Science* 279.5349, 1998, 325–326.
- Lillios et al. 2016*: K. Lillios/A. Blanco-González/B. Lee Drake/J. A. López-Sáez, Mid-Late Holocene Climate, Demography, and Cultural Dynamics in Iberia. A Multi-Proxy Approach. *Quaternary Science Reviews* 135, 2016, 138–153.
- López-Sáez et al. 2014a*: J. A. López-Sáez/A. Abel Schaad/S. Pérez Díaz/A. Blanco González/F. Alba Sánchez/M. Dorado/B. Ruiz Zapata/M. J. Gil García/C. Gómez González/F. Franco Múgica, Vegetation History, Climate and Human Impact in the Spanish Central System over the Last 9000 Years. *Quaternary International* 353, 2014, 98–122.
- López-Sáez et al. 2014b*: J. A. López-Sáez/S. Alba Sánchez/T. Nájera Colino/F. Molina González/S. Pérez Díaz/S. Sabariego Ruiz, Paleoambiente y sociedad en la Edad del Bronce de La Mancha. *La Motilla del Azuer*. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 24, 2014, 391–422.
- López-Sáez et al. 2015*: J. A. López-Sáez/S. Pérez Díaz/S. Alba Sánchez/S. Núñez de la Fuente, Paisaje cultural y paleoclimatología durante la Edad del Bronce de La Mancha. In: M. Mejías/L. Benítez de Lugo Enrich/J. A. López-Sáez/C. Esteban (eds.), *Arqueología, hidrogeología y medio ambiente en la Edad del Bronce de La Mancha*. La Cultura de las Motillas (Madrid 2015) 95–105.
- Magny et al. 2009*: M. Magny/B. Vannière/G. Zanchetta/E. Fouache/G. Touchais/L. Petrika/C. Coussot/A. V. Walter-Simonnet/F. Arnaud, Possible Complexity of the Climatic Event around 4300–3800 cal. BP in the Central and Western Mediterranean. *The Holocene* 19, 2009, 823–833.
- Mayewsky et al. 2004*: P. A. Mayewski/E. E. Rohling/J. Curt Stager/W. Karlén/K. A. Maasch/L. David Meeker/E. A. Meyerson/F. Gasse/S. Van Kreveld/K. Holmgren/J. Lee-Thorp/G. Rosqvist/F. Rack/M. Staubwasser/R. R. Schneider/E. J. Steig, Holocene Climate Variability. *Quaternary Research* 62, 2004, 243–255.
- Mejías Moreno et al. 2014*: M. Mejías Moreno/L. Benítez de Lugo Enrich/J. del Pozo/J. Moraleda, Los primeros aprovechamientos de aguas subterráneas en la Península Ibérica. *Las motillas de Daimiel en la Edad del Bronce de La Mancha*. *Boletín Geológico y Minero* 125.4, 2014, 455–474.

- Mejías Moreno et al. 2015*: M. Mejías Moreno/L. Benítez de Lugo Enrich/J. A. López-Sáez/C. Esteban López (eds.), *Arqueología, hidrogeología y medio ambiente en la Edad del Bronce de La Mancha. La Cultura de las Motillas* (Madrid 2015).
- Mejías et al. 2020*: M. Mejías Moreno/L. Benítez de Lugo Enrich/J. A. López Sáez/K. T. Lillios, *La Cultura de las Motillas de La Mancha. Testigos del Evento Climático 4.2 ka cal BP*. *Boletín Geológico y Minero* 131.1, 2020, 91–110.
- Menotti 1999*: F. Menotti, *The Abandonment of the ZH-Mozartstrasse Early Bronze Age Lake Settlement. GIS Computer Simulations of the Lake Level Fluctuation Hypothesis*. *Oxford Journal of Archaeology* 18.2, 1999, 143–155.
- Menounos et al. 2008*: B. Menounos/J. J. Clague/G. Osborn/B. H. Luckman/T. R. Lakerman/R. Minkus, *Western Canadian Glaciers Advance in Concert with Climate Change c. 4.2 ka*. *Geophysical Research Letters* 35.7, 2008, L07501.
- O'Brien et al. 1995*: S. R. O'Brien/P. A. Mayewski/L. D. Meeker/D. A. Meese/M. S. Twickler/S. I. Whitlow, *Complexity of Holocene Climate as Reconstructed from Greenland Ice Core*. *Science* 270, 1995, 1962–1969.
- Olalde et al. 2019*: I. Olalde/S. Mallick/N. Patterson/N. Rohland/V. Villalba-Mouco/M. Silva/K. Dulas/C. J. Edwards/F. Gandini/M. Pala/P. Soares/M. Ferrando-Bernal/N. Adamski/N. Broomandkoshbacht/O. Cheronet/B. J. Culleton/D. Fernandes/A. M. Lawson/M. Mah/J. Oppenheimer/K. Stewardson/Z. Zhang/J. M. Jiménez Arenas/I. J. Toro Moyano/D. C. Salazar-García/P. Castanyer/M. Santos/J. Tremoleda/M. Lozano/P. García Borja/J. Fernández-Eraso/J. A. Mujika-Alustiza/C. Barroso/F. J. Bermúdez/E. Viguera Mínguez/J. Burch/N. Coromina/D. Vivó/A. Cebrià/J. M. Fullola/O. García-Puchol/J. I. Morales/F. X. Oms/T. Majó/J. M. Vergès/A. Díaz-Carvajal/I. Ollich-Castanyer/F. J. López-Cachero/A. M. Silva/C. Alonso/G. Delibes de Castro/J. Jiménez Echevarría/A. Moreno-Márquez/G. P. Berlanga/P. Ramos-García/J. Ramos Muñoz/E. Vijande Vila/G. Aguilera Arzo/Á. Esparza Arroyo/K. T. Lillios/J. Mack/J. Velasco-Vázquez/J. Waterman/L. Benítez de Lugo/M. Benito-Sánchez/B. Agustí/F. Codina/A. Esparza/G. de Prado/A. Estalrich/A. Fernández Flores/C. Finlayson/G. Finlayson/S. Finlayson/F. Giles-Guzmán/A. Rosas/V. Barciela González/G. García Atiénzar/M. S. Hernández Pérez/A. Llanos/Y. Carrión Marco/I. Collado Beneyto/D. López-Serrano/M. Sanz Tormo/A. C. Valera/C. Blasco/C. Liesau/P. Ríos/J. Daura/M. J. de Pedro Michó/A. A. Díez-Castillo/R. Flores Fernández/J. Francès Farré/R. Garrido-Pena/V. S. Gonçalves/E. Guerra-Doce/A. M. Herrero-Corral/J. Juan-Cabanilles/D. López-Reyes/S. B. McClure/M. Merino Pérez/A. Oliver Foix/G. Pascual/M. Sanz Borràs/A. C. Sousa/J. M. Vidal Encinas/D. J. Kennett/M. B. Richards/K. W. Alt/W. Haak/R. Pinhasi/C. Lalueza-Fox/D. Reich, *The Genetic History of the Iberian Peninsula over the Last 8000 Years*. *Science* 363, 2019, 1230–1234. DOI: 10.1126/science.aav4040.
- Parker et al. 2006*: A. G. Parker/A. S. Goudie/S. Stokes/K. White/M. J. Hodson/M. Manning/D. Kennet, *A Record of Holocene Climate Change from Lake Geochemical Analyses in Southeastern Arabia*. *Quaternary Research* 66.3, 2006, 465–476.
- Peiser 1998*: B. J. Peiser, *Comparative Analysis of Late Holocene Environmental and Social Upheaval. Evidence for a Global Disaster around 4000 BP*. *British Archaeological Reports, International Series* 278, 1998, 117–139.
- Roland et al. 2014*: T. P. Roland/C. J. Caseldine/D. J. Charman/C. Turney/M. J. Amesbury, *Was there a '4.2 ka Event' in Great Britain and Ireland? Evidence from the Peatland Record*. *Quaternary Science Reviews* 83, 2014, 11–27.
- Stanley et al. 2003*: J. D. Stanley/M. D. Krom/R. A. Cliff/J. C. Woodward, *Nile Flow Failure at the End of the Old Kingdom, Egypt. Strontium Isotopic and Petrologic Evidence*. *Geoarchaeology* 18.3, 2003, 395–402.
- Staubwasser et al. 2003*: M. Staubwasser/F. Sirocko/P. M. Grootes/M. Segl, *Climate Change at the 4.2 ka BP Termination of the Indus Valley Civilization and Holocene South Asian Monsoon Variability*. *Geophysical Research Letters* 30.8, 2003, 1425.

- Teixidó et al. 2013*: T. Teixidó/E. G. Artigot/J. A. Peña/F. Molina/T. Nájera/F. Carrión, Geoarchaeological Context of the Motilla de la Vega Site (Spain) Based on Electrical Resistivity Tomography. *Archaeological Prospection* 20, 2013, 11–22.
- Thompson et al. 2002*: L. G. Thompson/E. Mosley-Thompson/M. E. Davis/K. A. Henderson/H. H. Brecher/V. S. Zagorodnov/T. A. Mashiotta/L. Ping-Nan/V. N. Mikhalenko/D. R. Hardy/J. Beer, Kilimanjaro Ice Core Records Evidence of Holocene Climate Change in Tropical Africa. *Science* 298, 2002, 589–593.
- Villalba-Mouco et al. 2021*: V. Villalba-Mouco/C. Oliart/C. Rihuete-Herrada/A. Childebayeva/A. B. Rohrlach/M. I. Fregeiro/E. Celdrán Beltrán/C. Velasco-Felipe/F. Aron/M. Himmel/C. Freund/K. W. Alt/D. C. Salazar-García/G. García Atiénzar/M. Paz de Miguel Ibáñez/M. S. Hernández Pérez/V. Barciela/A. Romero/J. Ponce/A. Martínez/J. Lomba/J. Soler/A. Pujante Martínez/A. Avilés Fernández/M. Haber-Urriarte/C. Roca de Togores Muñoz/I. Olalde/C. Lalueza-Fox/D. Reich/J. Krause/L. García Sanjuán/V. Lull/R. Micó/R. Risch/W. Haak, Genomic Transformation and Social Organization during the Copper Age–Bronze Age Transition in Southern Iberia. *Science Advances* 7.47, 2021, eabi7038. DOI: 10.1126/sciadv.abi7038.
- Weiss et al. 1993*: H. Weiss/M. A. Courty/W. Wetterstrom/F. Guichard/L. Senior/R. Meadow/A. Curnow, The Genesis and the Collapse of Third Millennium North Mesopotamian Civilization. *Science* 26, 1993, 995–1004.
- Wilkinson 1997*: T. J. Wilkinson, Environmental Fluctuations, Agricultural Production and Collapse. A View from Bronze Age Upper Mesopotamia. In: D. Nüzhet/G. Kukla/H. Weiss (eds.), *Third Millennium B.C. Climate Change and Old World Collapse*. NATO ASI Series 1.49 (Berlin 1997) 67–106.
- Wu/Liu 2004*: W. Wu/T. Liu, Possible Role of the ‘Holocene Event 3’ on the Collapse of Neolithic Cultures around the Central Plain of China. *Quaternary International* 117.1, 2004, 153–166.

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Exploitation of Copper Mining Resources during the Bronze Age in the Eastern Sierra Morena

Keywords: mining, copper/silver, archaeometallurgy, territory, exchange, Sierra Morena, Copper and Bronze Ages

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Abstract

Metal production has been and is a key element in the historiographic debate on the development and socio-economic organisation of societies in the Copper and Bronze Ages in the southeast of the Iberian Peninsula. Although research has focused on different aspects of prehistoric

copper-based metallurgy, extractive mining activity has been left in the background. In recent years, thanks, amongst other things, to the field work carried out by the Peñalosa Project team in the eastern Sierra Morena (Linares-La Carolina-Andújar mining district) and on the northern slopes of the Sierra Nevada and Sierra de Baza, this situation is changing. This paper evaluates the archaeological-metallurgical evidences that shows the importance of the mining and metallurgical activity practised by the communities between 2200–900 BC in the eastern Sierra Morena, placing this region as one of the main copper and silver producing centres in the south of the peninsula during recent prehistory.

Introduction

Studies on the recent prehistory of the southeast of the Iberian Peninsula have a long tradition that goes back to the end of the 19th cent. AD (Siret/Siret 1888), which has made the culture of El Argar (Bronze Age, 2200–1550 calBC) the most studied in Iberia (Lull 1983; Aranda et al. 2015). Since the first research, the production of metal, based on copper and silver, has been considered a key element in the historiographic debate on the development and socio-economic organisation of the communities of the Copper and Bronze Ages in the southeast of the Iberian Peninsula. Since the seventies of the last century, two opposing theories have been proposed on the role of metallurgical activity and the metal, based on divergent theoretical assumptions. On the one hand, several researchers have stated that craft specialisation in metallurgy was a crucial

factor in the emergence of social inequalities (Lull 1983; Molina et al. 1986; Contreras/Cámara 2002; Lull et al. 2010a) and that the scale of metallurgical production became very intense on a regional level (Moreno/Contreras 2010). Other researchers, on the other hand, attribute a secondary value to this activity, stating that it does not require full-time specialisation. Its development would have been the result, not the cause, of a social hierarchy that would be related more to the changes that occurred in the organisation of the production of goods related to subsistence during the Bronze Age, raising a local production of low intensity (Gilman 1987; Montero/Murillo 2010).

However, this debate has focused on a resource already transformed, copper metal, whereas the prospecting and extractive activity of copper ores is not present in the discussion, even though it is a basic issue to understand the metallurgical process in its entirety, mainly for issues as important as the mobility of resources and the scale of production. This absence of mining in the historiographic discourse is largely due to the scarce evidence of prehistoric mining documented in the southeast of the peninsula. Much of the research has focused on the study and analysis of metal objects, mostly from burial mounds, while the study of the archaeological record of extractive work has been almost absent, due to the difficulty of identifying them since in most territories the metalliferous veins have been exploited in later stages, thus erasing the oldest traces.

This scarcity of archaeological evidence of copper mining has been used in different orientations by the two currents mentioned above. Thus, the first group focuses on mining in the eastern Sierra Morena (Lull et al. 2010a; Moreno/Contreras 2010), while the second group explains this absence by the great wealth of copper ore in the southeast, whose exploitation of a local nature would have left very scarce and unrecognisable evidence on the surface today (Montero/Murillo 2010). For all these reasons, a common practice employed in the last two decades has been to carry out chemical and lead isotope analyses of Argaric artefacts (slag, objects, crucibles, etc.), which has made it possible to indirectly identify the existence of an exploitation phase in the mineral deposits of the mining areas of the southeast during recent

prehistory, thus making up for the lack of direct archaeological evidence.

Information and evidence about copper mining in the Bronze Age in eastern Andalusia and, in general, in the southeast of the peninsula, has been very scarce until the beginning of the 21st cent. AD. As in the rest of the mining regions of the Iberian Peninsula, the starting point for research has been the reports of geologists and mining engineers since the end of the 19th cent. AD, especially the inventory made by C. Domergue (1987). In his work, the author cites nine copper mines with mining hammers with a central slot of ophthalmic and diorite in the province of Jaén, eight in Andújar: Arroyo Valquemado (J1), Cerro de los Venados (J2), Valquemado mine (J3), Arroyo de la Lisea/Aliseda (J4), El Fresnillo (J5), El Humiliadero (J6), Navalasno (J7), Los Escoriales (J8) and one in Baños de la Encina, the mine in the industrial area (J25). In Almería, a copper chisel from the Chalcolithic period has been found in the Virgen de la Huerta mine (Herrerías) (Domergue 1987, AL3) and there are diorite maces with a central groove on the southern slope of Cerro Minado (Huercal Overa, Almería) (Domergue 1987, AL 6). In the latter, texts from the early 20th cent. AD also mention the presence of deer antlers in mining work (García Asensio 1910; Escanilla 2016, 208). In addition to this evidence and indications, there is also a possibility of workings next to the Chalcolithic site of El Malagón (Cullar) (Moreno 1993), some copper mines discovered in Sierra de Alhamilla in Almería (Rothenberg et al. 1988) and small workings located next to the Copper Age site of Los Cortijillos (Baza, Granada) (Sánchez Quirantes et al. 2014).

This panorama has begun to change in the last two decades, above all thanks to the research work being carried out by different interdisciplinary research teams, specifically: the Peñalosa Project in the eastern Sierra Morena (Jaén), Marquesado del Zenete and Sierra de Baza (Granada) (Contreras et al. 2005; Arboledas/Contreras 2010; Contreras/Dueñas 2010; Arboledas/Alarcón 2018; Arboledas et al. 2017) and the team of researchers from the Universidad Autónoma de Barcelona in the region of Murcia and the north of the province of Almería (Delgado et al. 2014; Escanilla/Delgado 2015; Escanilla 2016). The investigations of these teams

Mine	Localisation	Province	Metal	Chronology	Dating method	Bibliography
Candalares	Marmolejo	Jaén	Cu	PR-EB, R	TP, TT, TW, SRV	Arboledas et al. in press
Piedra del Águila	Andújar	Jaén	Cu	PR, PRO	TW, TP, OM	Arboledas et al. in press
Barranco Valpeñoso	Marmolejo	Jaén	Cu	PR-EB, R	TW, TP, TT, SRV	Arboledas et al. in press
Reuelta Molinicos	Marmolejo	Jaén	Cu	PR	TT, TW	Arboledas et al. in press
Los Castellones	Andújar	Jaén	Cu	PR	TT, TW	Arboledas et al. in press
Arroyo de la Grieta	Andújar	Jaén	Cu	PR	TT, TW, SRV, OM	Arboledas et al. in press
MingorrAMOS/Himiliadero	Andújar	Jaén	Cu	PR, R	TT, TW, TP	Domergue 1987, J6; Arboledas et al. in press
NavalasnO	Andújar	Jaén	Cu	PR, R	TW, TT, SRV	Domergue 1987, J7; Arboledas et al. in press
Nava de la Cabrera	Marmolejo	Jaén	Cu	PR	TW, TT	Arboledas et al. in press
Las Minetas	Andújar	Jaén	Cu	PR	TW, TT	Arboledas et al. in press
Las Minetas II	Andújar	Jaén	Cu	PR	TW, TT	Arboledas et al. in press
Laguna de los Llanillos/Arroyo Valquemado?	Andújar	Jaén	Cu	PR	TW, TT	Domergue 1987, J1; Arboledas et al. in press
Casa mina de Valquemado	Andújar	Jaén	Cu	PR	TW, TT	Domergue 1987, J3; Arboledas et al. in press
Casa vieja de Valquemado	Andújar	Jaén	Cu	PR	TW, TT	Arboledas et al. in press
Cerro de los Venados	Andújar	Jaén	Cu	PR	TW, TT	Domergue 1987, J2; Arboledas et al. in press
Los Escoriales	Andújar	Jaén	Cu, Pb	PR, R	TW, TT, TP, SRV	Domergue 1987, J8
Arroyo Aliseda	Andújar	Jaén	Cu	PR	TW, TT	Domergue 1987, J4
Arroyo Fresnedillo	Andújar	Jaén	Cu	PR	TW, TT	Domergue 1987, J5
El Polígono	Baños de la Encina	Jaén	Cu	PR-C, PR-EB, R	TW, TT, TP, SRV, LIA	Domergue 1987, J25; Arboledas/Contreras 2010
José Palacios-Dña Eva	Baños de la Encina	Jaén	Cu	PR-C, PR-EB, PROT, R	TW, TT, TP, LIA, SRV, C14	Arboledas et al. 2015
Mina Arrayanes	Linares	Jaén	Cu, Pb	PR, R	TW, TT, TP,	
Los Cortijillos	Baza	Granada	Cu	PR-C?	TW, OM	
El Malagón	Cullar	Granada	Cu	PR-C?	TW	
Cerro Minado	Huércal-Overa	Almería	Cu	PR-C	TT, TP, C14	Escanilla 2016
Balsicas	Mazarrón	Murcia	Cu	PR	TT	Escanilla 2016
Filón Consuelo	Escombreras	Murcia	Cu	PR	TT	Escanilla 2016

Table 1. Mining exploitations in the southeast of the Iberian Peninsula (provinces of Jaén, Granada, Almería and Murcia). Chronology: PR = Recent Prehistory; PR-C = Recent Prehistory, Copper Age; PR-EB = Recent Prehistory, Bronze Age; PRO = Protohistory and R = Roman. Dating method: C14 = Radiocarbon Dating; TP = Typology of Pottery; TT = Typology of Tools; TW = Typology of Work; LIA = Lead Isotopes Analysis; SRV = Slags and Reduction Vessels; OM = Other Material or Analysis.

have allowed the identification of new evidence of mining activity ascribed to recent prehistory, in which the great concentration of documented records in the eastern Sierra Morena stands out (Arboledas et al. 2017; Arboledas/Alarcón 2018). Thus, a total of 26 mining operations are currently known in the southeast, with archaeological evidence of their exploitation during recent prehistory. Among these are those mentioned in the bibliography as the new findings contributed by both research teams mentioned above (*table 1*).

Taking into account this panorama, the present work carries out an analysis of the mining and metallurgical evidence identified in the eastern Sierra Morena, an area also known as the mining district of Linares-La Carolina and Andújar. The volume and scale of these remains reveal the importance that mining and metallurgical activity had among the prehistoric communities of the eastern Sierra Morena between 2200–900 BC, making this geographic area one of the main copper and silver producing centres of the southern Iberian Peninsula during the Bronze Age.

Mining Resources Exploited in the Eastern Sierra Morena

The mining region in the province of Jaén is geologically located in the southern region of the Iberian Plateau, where Palaeozoic materials (shales, slates and quartzite) and plutonic rocks cut by a network of fractures and seams predominate (IGME 1977, 3 f.).

Mineralisations in this area usually appear as part of veins and seams, rich in lead-silver (silver galena) and copper minerals, which are embedded in granites, in the contact zones between plutonic and sedimentary rocks and in Ordovician quartzite and slate. This geology has conditioned the methods and techniques used in the exploitation of these mineral deposits throughout history, with a predominance of open pit workings (trenches, small open pits, pits and shafts, wells and galleries) as opposed to underground workings (galleries, chambers and rooms-and-pillars and large short ones) as it occurs in other mines in the peninsula.

The seams represent basically lead (Pb), lead-silver (Pb-Ag), copper-lead (Pb-Cu) and copper-iron

(complex sulphides, Cu-Fe) mineralisations, besides some tin-tungsten (Sn-W). Mineralisation in this region presents a great variety. There are areas where the seams are rich in silver galena with important silver grades, such as La Carolina-El Centenillo and in others, such as Linares and Andújar (granitic batholite), they present important copper mineralisations in the surface levels and lead (galena) with a low silver grade in the depths (Azcarate 1972).

To date, all of the prehistoric mines in this region have been mining copper seams, mostly embedded in the granite of the Los Pedroches sector of Gien, although there is evidence of deposits of silver galena in the settlement of Peñalosa (Contreras 2000). In this sense, it should be noted that most of the mining operations with evidence of lithic tools in the province of Córdoba (Domergue 1987) are also excavated in the seams located in the same lithology (Los Pedroches batholite). On the contrary, there is no evidence of material culture that testifies that the seams rich in lead-silver mineralisation in this region (La Carolina-El Centenillo) were exploited before Roman times. However, lead isotope analyses of silver materials from Argaric sites in the southeast of the peninsula show the possibility that the native silver used came from the central and eastern Sierra Morena vein deposits (Bartelheim et al. 2012).

During the early stages of mining in this region, both simple, native-state and polymetallic copper mineralisations would be exclusively exploited. This is the case of the site of Peñalosa (Baños de la Encina) (*fig. 1*). Composition analyses carried out on mineral samples recovered in the archaeological contexts of this site have determined that minerals from two groups of polymetallic mines were smelted: one with copper ores, in which copper is the predominant mineral (José Palacios mines and probably, in the absence of archaeometallurgical analyses, Salas de Galiarda); and the other with lead-copper ores (Polígono mine) (Moreno et al. 2010; Moreno/Contreras 2010, 60; Hunt et al. 2011).

The copper ores used are mainly copper oxides and carbonates (cuprite, azurite, malachite etc.) from the upper levels of the seams, oxidised on contact with rainwater. At these levels, the



Fig. 1. Aerial view of the metallurgical settlement of Peñalosa (Baños de la Encina, Jaén) (photo by Proyecto Peñalosa).

existence of native silver and copper is also very frequent. At certain depths, unaltered copper minerals are found, as well as complex sulphides associated with iron, such as chalcopyrite or pyrite, which were exploited, above all, from the Roman period (Tamain 1972).

Prehistoric Mining in Eastern Sierra Morena

One of the main handicaps when investigating prehistoric metal mining is being able to identify traces or evidence of older mining activity. In most cases, the continued exploitation of the seams in later periods has masked, altered or destroyed these remains. Even so, the research work carried out by the University of Granada in this region has made it possible to increase the number of prehistoric mining operations already identified. From the nine mines registered by C. Domergue in his catalogue, the number was increased to 21, most of them documented in the Jandula-Cabrera valley (Arboledas et al. 2017). This area concentrates 80% of the prehistoric

mines recorded in the southeast of the peninsula (*table 1, fig. 2*). Obviously, these percentages may vary in the future as several studies are currently being carried out in the eastern part of the provinces of Granada and Almería.

The concentration of this number of exploitations in this region, some of them of large dimensions such as Los Candalares, Polígono, etc. (Arboledas et al. 2017; Arboledas/Alarcón 2018), together with the amount of metallurgical remains found in the Argaric settlement of Peñalosa (Contreras et al. 2014; Moreno et al. 2017) and lead isotope analyses of copper- and silver-based objects from archaeological sites suggest that the eastern and central Sierra Morena was the main supplier of copper and silver metal to the southeast of the peninsula during the Bronze Age (Moreno/Contreras 2010; Bartelheim et al. 2012; Arboledas/Alarcón 2018). In this context, there must also have been small, minor mines distributed throughout the southeast, which are very difficult to identify and which would also provide ore to nearby settlements (Escanilla 2016, 251; Bashore 2013; Bashore et al. 2014).

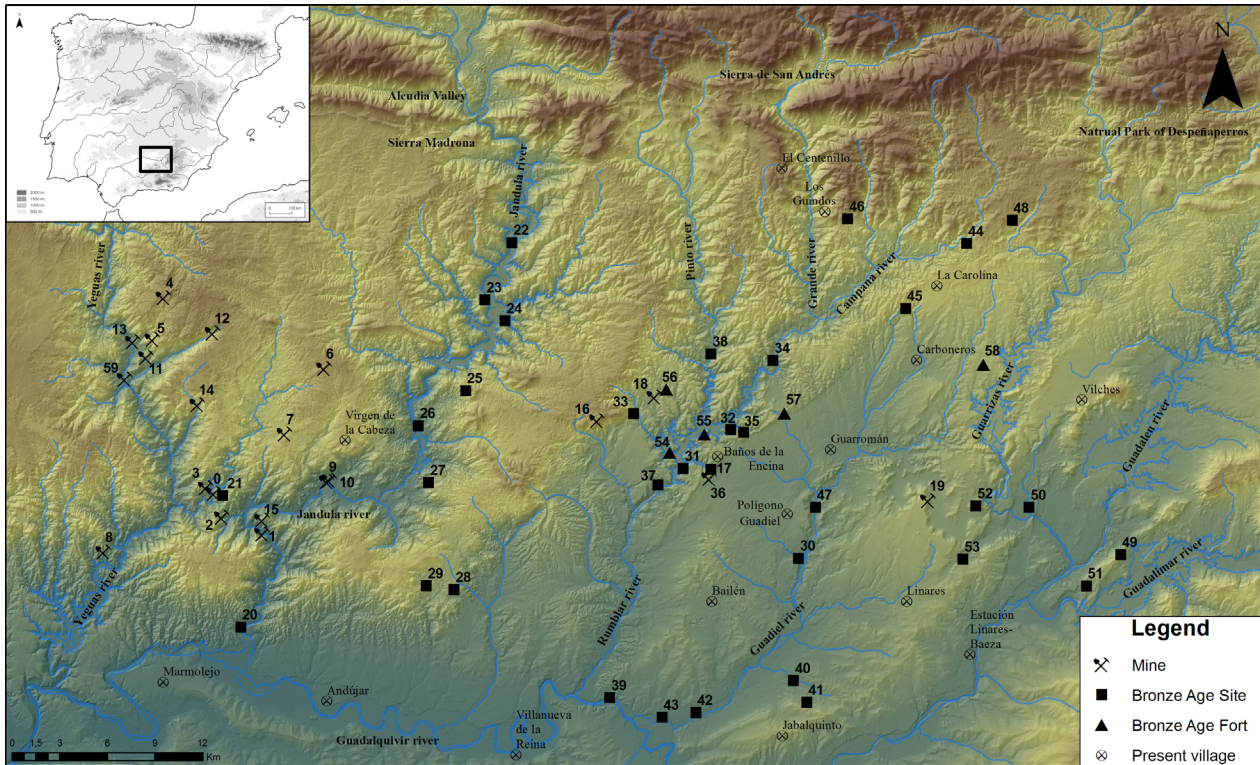


Fig. 2. Map with prehistoric mines and Bronze Age settlements in the eastern Sierra Morena. 0. Los Candalares, 1. Peñón Águila, 2. Barranco Valpeñoso, 3. Revuelta Molinicos, 4. Los Castellones, 5. Arroyo Grieta, 6. Mingorramos, 7. Navalasno, 8. Nava de la Cabrera, 9. Las Minetas, 10. Las Minetas II, 11. Laguna Llanillos, 12. Casa Valquemado, 13. Cerro los Venados, 14. Arroyo Aliseda, 15. Fresnedillo, 16. Salas de Galiarda, 17. Polígono, 18. José Palacios, 19. Arrayanes, 20. Cabrerizas, 21. Candalares, 22. Contadero, 23. Valtravieso, 24. Atalayón, 25. La Lancha, 26. Casa Peral, 27. Lagunilla, 28. Cerro Tornero, 29. Cerro Atalaya, 30. Cerro Buenaplata, 31. Peñalosa, 32. Verónica, 33. Los Castillejos, 34. Cerro de la Atalaya, 35. Basurero, 36. Castillo de Baños de la Encina, 37. Cerro de las Obras, 38. La Majada, 39. Sevilleja, 40. Cortijo de Sancho, 41. Fuente Nueva, 42. Estación de Espeluy, 43. Guadiel Norte, 44. El Castillo, 45. Torrecillas, 46. Cerro Castellones, 47. Cerro Pelao, 48. Cerro del Cura, 49. Giribaile, 50. Piélago, 51. Atalayuela, 52. Cerro de las Casas, 53. Castro Magdalena, 54. Morquigüelo, 55. Piedras Bermejas, 56. Cerro Burraca, 57. Cortijo de Salcedo, 58. Cerro Barragán, 59. Casa Vieja Valquemado (map by María Isabel Roger and Luis Arboledas).

Studies along the Rumblar valley point to the close relationship between settlements and mining. The two large mines studied show similar patterns. Near the Linares-Bailén depression is the El Polígono mine (*fig. 3*), associated with large settlements like Castillo de Baños, which would possibly control its exploitation and distribution to nearby sites such as Peñalosa (Arboledas/Contreras 2010). A similar model can be seen at the José Palacios mine (Baños de la Encina, Jaén), the second of three mines which supplied ore to the settlement of Peñalosa (Hunt et al. 2011; Arboledas et al. 2015) and whose exploitation would depend on the settlement of Los Castillejos (*fig. 4*). Therefore, the number of mining operations in the Rumblar valley is associated, and this is the important thing, with a territorial model

formed by settlements of different sizes in charge of the exploitation and distribution of copper ore, articulated in a strategic network completed by a series of forts that ensured the defence of the territory and gave it a regional dimension at the scale of production (Moreno/Contreras 2010).

From the beginning of both metal and non-metal mining, the first prehistoric miners employed two methods of exploitation that seem to be not so much subject to the technology of the time as to the geological characteristics of the terrain itself, the metallogenic composition, the thickness, dipping and direction of the mineral deposits. On the one hand, open-pit mining is represented by trenches, small cuts, pits, and tunnels from which small galleries and shallow shafts can be derived. On the other hand, there are the



Fig. 3. A. Polígono mine (Baños de la Encina); B and C. Trenches of the Polígono mine; D. Site of La Verónica (Baños de la Encina); E. Site of the Castillo de Baños de la Encina (photos by Proyecto Peñalosa).

underground works, represented by the galleries, shafts and exploitation chambers. Therefore, there is no standardised and homogeneous method for each chronological stage, but these types of work

have lasted for a long time and have been implemented with the then current technology of each time period until the industrial revolution and the use of the steam engine and explosives.

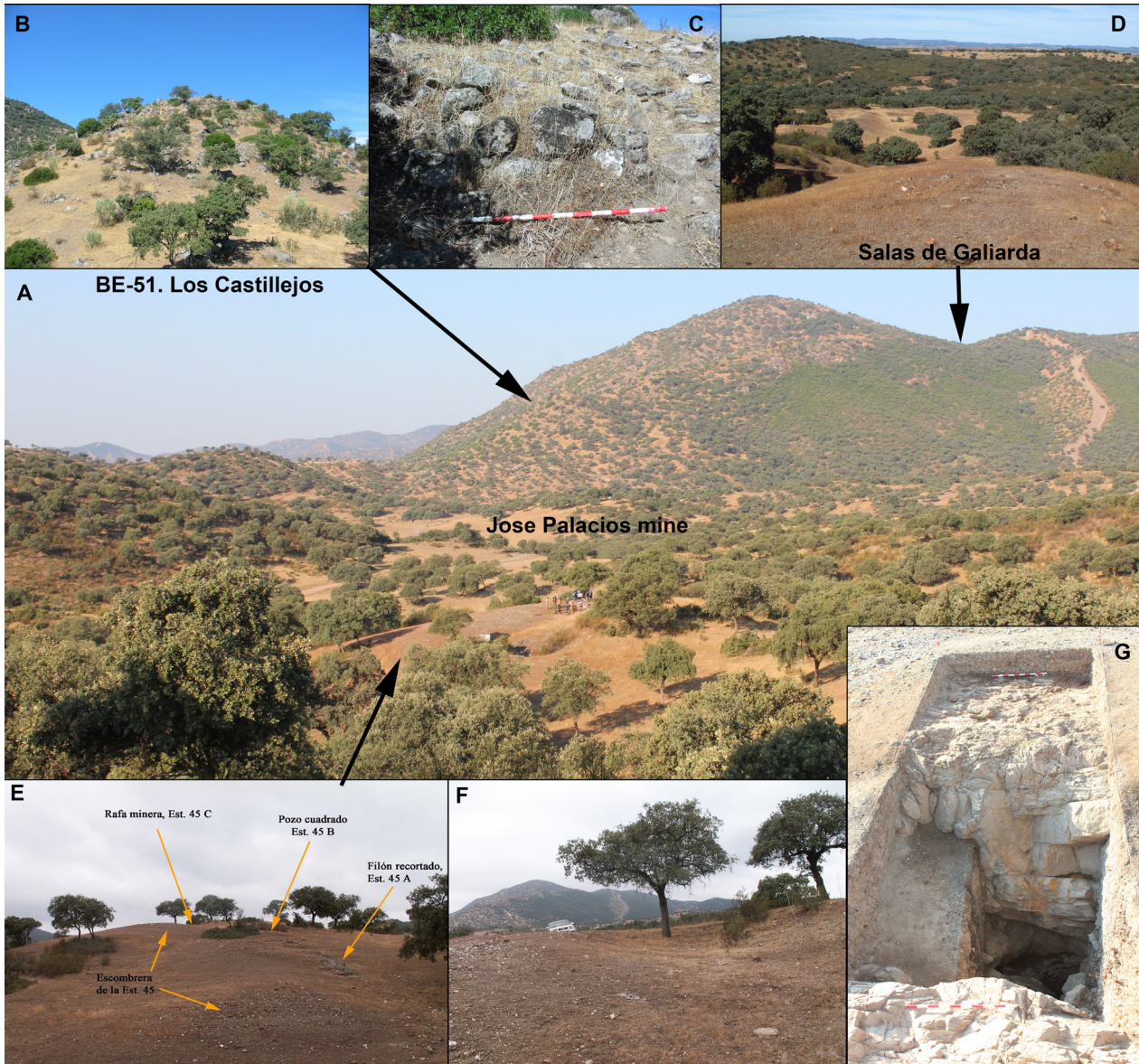


Fig. 4. A. Panoramic view of the José Martin Palacios/Doña Eva mine with the granite hill in the background of Navamorquin (Baños de la Encina); B and C. Argaric site of Los Castillejos (BE-51); D. Trench of Salas de Galiarda mina (Baños de la Encina); E. Mining remains of the José Martin Palacios mine (Baños de la Encina); F and G. Trench 1 of the José Martin Palacios mine before and after its excavation (photos by Proyecto Peñalosa).

Both on the Iberian Peninsula and in the rest of Europe it has been found evidences of these two exploitation methods, the techniques of which depend on the power and geological-metallogenic characteristics of the exploited ore deposit and the scale of production. On numerous occasions these two systems were simultaneously exploited in the same mine. For example, in the Rudna Glava mines (Serbia), both deep and surface workings were found (Jovanovic 1982, 1–15); in the Ross Island mines in Ireland (O’Brien 2004), in the El Áramo and El Milagro mines

(Asturias, Spain) (Blas Cortina 2007/2008; 2014) or in the Cabrières area, such as Pioch Farrus IV (Midi, France) (Carozza 2005, 649–652), underground workings in galleries and subhorizontal or subvertical chambers predominate (Carozza 2005), while in other mines such as those of Saint-Véran (Hautes Alpes, France) open-cast workings (trenches, shafts, etc.) predominate (Barge/Ancel 2003; Bourgarit et al. 2010).

In the case of the mines in the area concerned, the documented examples show a predominance of open-cast work, in the form of trenches and



Fig. 5. Los Candalares mine (Marmolejo): A. Trench of Sector Sur of the Los Candalares mine; B. Site of Los Candalares; C. Trench of Sector Norte of Los Candalares (photos by Proyecto Peñalosa).

shallow galleries, which have benefited the surface outcrops rich in oxidised and carbonate copper minerals and, probably, also native metals. Up to now, no deep underground mining has been documented although it cannot be ruled out that in some cases the miners continued with small underground workings following the richest mineralisations. The prehistoric miners would easily recognise the white colour of the quartz ridges on the surface, tinted by the striking colours of some minerals such as azurite (blue), malachite (green) or native copper (orange). On the walls of some trenches, traces of copper mineralisation can still be seen, especially malachite and azurite (Arboledas/Alarcón 2018, 142).

These open-cast mines have an irregular layout and variable dimensions, as a result of the emptying of the richest parts of the reef, which is typical of pillage mining. As is logical, its morphology and dimensions depend on the type of mineral deposit, the direction and power, the location

of the ore, its richness and other physical and geological conditions. Thus, trenches have been found which reach a length of more than 100m and a width of about 4m in the mines of Los Candalares (Marmolejo) (*fig. 5*), Navalasno (Andújar) and Polígono (Baños de la Encina) and smaller jobs such as those in the trenches of the mines of Las Minetas (Andújar) (*fig. 6*) and José Martín Palacios (Baños de la Encina) (*fig. 2*), which are about 10 to 15m long, 1-3.5m wide and only 8m deep (Arboledas et al. 2015).

All of the workings have their attached dump heaps. In those cases where no Roman, medieval or contemporary exploitation phases have been observed, the dumps are usually highly integrated into the landscape among the prevailing vegetation, which may be a sign of their age. In all the catalogued mines, either inside them or in the cuttings, numerous lithic tools have been identified that are linked to the process of extracting the ore as well as evidence of its crushing. These



Fig. 6. A. Las Minetas mine (Andújar). B. Trench of Las Minetas mine (photos by Proyecto Peñalosa).

are mostly mallets/hammers and ophite and diorite picks with central grooves, as well as some cup stones, polished picks, hand-mills and barquiform grinding stones (*fig. 7*). Obviously, these last two instruments would be related to the processing of the ore, specifically to the crushing prior to its metallurgical treatment, although we should not rule out their relationship with subsistence activities such as the preparation of food at the mine. In this sense, the studies carried out on the barquiform grinding stones of Bronze Age settlements such as Fuente Álamo (Risch 1997; Risch et al. 2002) and even those of Peñalosa (Carrión 2000) have demonstrated the multi-functionality of these elements used both for the grinding of ore and grain. In the case of the polished stone axes and hoes, their presence could be related to the felling of wood needed to shore up or prop up some areas, as well as the fuel needed for the metallurgical process and even for their use in the process of blasting the ore with the help of fire.

The morphological and weight differences of the lithic hammer stones are criteria to be taken

into account in the functional interpretation. In the mines of the eastern Sierra Morena, stone tools (hammers, mallets and picks) of different shapes and sizes have been documented, mostly of intrusive igneous origin and with a very hard ophitic composition from secondary deposits. Hammers of average weight (from 0.8 to 5kg max.) would be used for both direct and indirect percussion (Arboledas et al. 2017). Their typology corresponds to the characteristics of the mining hammers documented in other mines, such as those in the southwest (Hunt 2003) or those in Asturias (Blas-Cortina 2007/2008). In the case of large hammers (over 5kg), their possible use has been considered in sling structures, located in front of the rock's working surface (Blas Cortina 2007/2008). But these large hammers could also be used for initial crushing of the extracted ore with the help of some leverage system, similar to the poles that are known to extract water from wells.

Although there is almost no material evidence of their existence in the mines of the southeast, bone tools, even deer and wooden ones, would

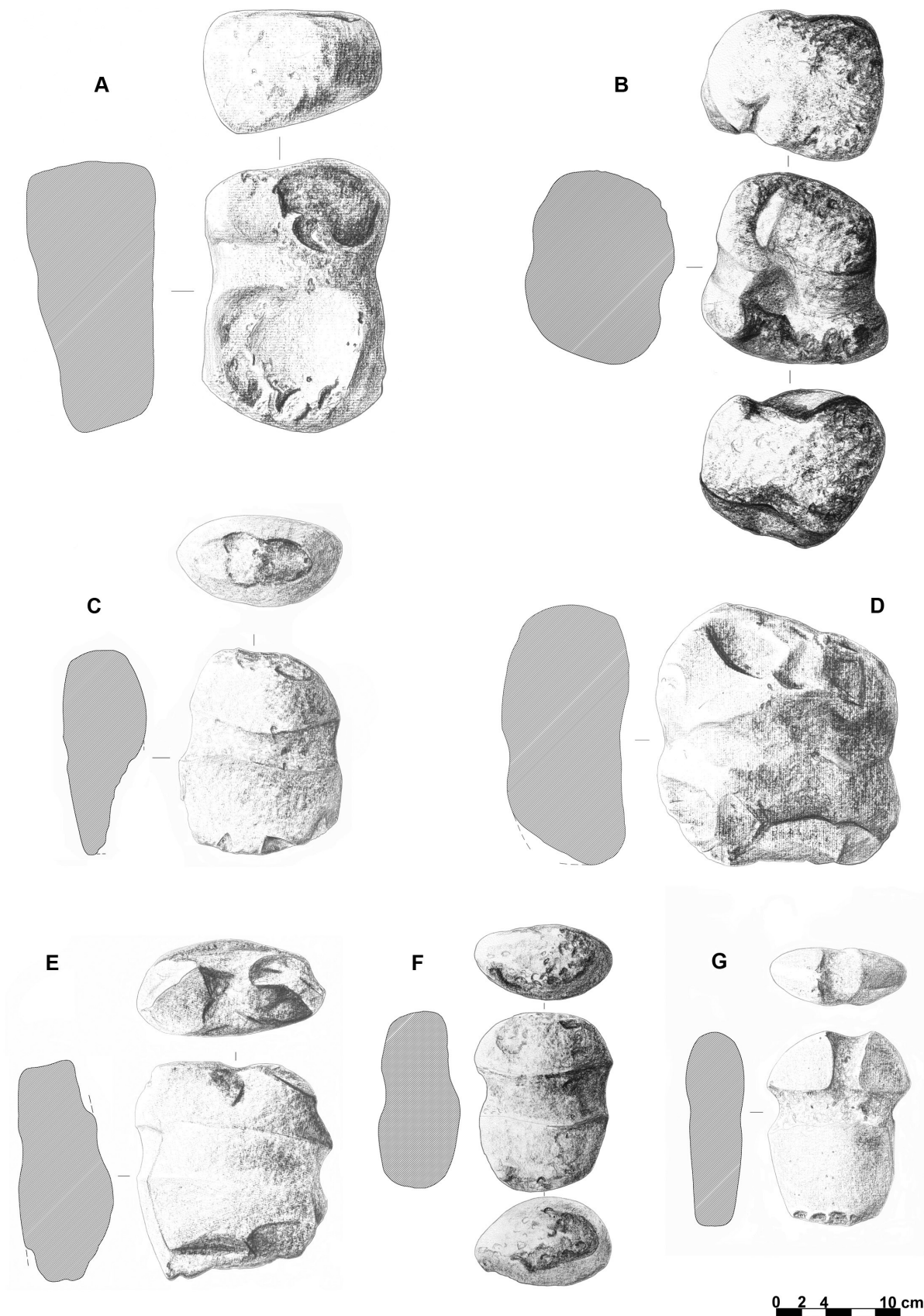


Fig. 7. Mining mallets/hammers with a central groove from the prehistoric mines of the eastern Sierra Morena: A. Arroyo de la Grieta (Andújar); B. José Martín Palacios; C and G. Los Candalares (Marmolejo); D. Reuelta de Molínicos (Andújar); E. Site Los Candalares; F. El Polígono (elaborated by Luis Arboledas).

surely have been used in the mining process, such as chisels, levers, pickaxes and shovels. The only reference of this type of material comes from the Cerro Minado mine. Two authors from the early 20th cent. AD mention the discovery of deer horn instruments in this mine (Calvert 1903; García Asensio 1910; Escanilla 2016, 208).

The use of fire-setting in the Sierra Morena mines has been confirmed. This practice has also been widely confirmed in other mines on the peninsula and in the rest of Europe, such as El Áramo and La Profunda (Asturias) (Blas Cortina 2014), Ross Island (Ireland) (O'Brien 2004) or Pioch Farus IV in Cabrières (France) (Ambert et al. 2009). A direct indication of its use is the existence of concave, alveolar and rounded cavities, in addition to the presence of coal and blackened walls. In this mining region of the eastern Sierra Morena, two indications of the use of fire have been found, one in the José Martín Palacios/Doña Eva mine and another in the El Polígono mine (Arboledas et al. 2015, 150). Some ore fragments collected in the settlement of Peñalosa have provided relevant data about this extraction technique used by the miners. These fragments have numerous fissures in the interior of which globular formations (bubbles) can be seen when observed closely under a binocular lens as indelible traces of this extraction method (fire-setting) (Moreno et al. 2010).

How to Date a Prehistoric Mine

The other major obstacle to the study of prehistoric mines has been and is their chronological assignment. In cases where there is no excavation information or radiocarbon dating, the chronology of mining operations has been based on a combination of a series of aspects such as the typology of the mines, the technology used in their exploitation, their link to nearby prehistoric settlements and, above all, the material culture found on the surface during prospecting work (mainly hammers/picks and ceramics).

In recent years, lead isotope analyses have made it possible to indirectly date the existence of a prehistoric exploitation phase in the mines of the southeast of the peninsula, where no archaeological evidence has been recorded. In this way

it was confirmed that the mine in the Polygon (Baños de la Encina) was exploited during the Copper and Bronze Ages as indicated by the material culture found during the extensive and systematic prospecting carried out (Arboledas/Contreras 2010; Hunt et al. 2011). Also it was initially determined that the José Martín Palacios mine was also mined during the Bronze Age as certified by its subsequent excavation and the ¹⁴C dating (Arboledas et al. 2015).

As it happens in other regions, most of the identified evidences so far, mainly from lithic instruments, only allows to generically attribute these exploitations to later prehistory (Copper and Bronze Ages) and the beginning of the Iron Age. These elements only allow to confirm the existence of an exploitation phase during recent prehistory, since they have been found in different archaeological mining records in the Iberian Peninsula and Europe from the Copper Age to the Final Bronze Age (Ambert et al. 2009; Blas Cortina et al. 2013; Blanco/Rothenberg 1981, fig. 30; Timberlake 2003). Typological variations are not chronological indicators of a particular period (Hunt 2003). On the contrary, the existence in four mines (Candalares, Arroyo la Grieta, Peñón del Águila and José Martín Palacios) of Argaric pottery, crucible fragments and immature slag, as documented in different Argaric settlements in this region, are indisputable indicators that these mines were exploited at some time during the Bronze Age (Arboledas et al. 2015; Arboledas/Alarcón 2018).

For the moment, the only radiocarbon dates for prehistoric mining in the southeast of the peninsula come from the mines of Cerro Minado (Huércal-Overa) and José Martín Palacios (Baños de la Encina). In the former, a sample of coal extracted from a section of the dump has been dated to the end of the Copper Age (2466–2347 calBC, MAMS-18508) (Delgado et al. 2014, 30). In the second one, three coal samples collected in different contexts were dated. One of them, coming from the base of the dump with ceramic material from the Bronze Age, has provided a date of the beginning of the Bronze Age (2205–2030 calBC, CNA-1004) (Arboledas et al. 2015, 151).

Therefore, with the exception of the mines of Cerro Minado, José Martín Palacios, Polígono, Candalares, Arroyo de la Grieta and Peñón del Águila,

which have been found to have been exploited during the Bronze Age, most of the 26 mines identified as prehistoric in the southeast of the peninsula have been generically attributed to recent prehistory due to the presence of lithic instruments, without being able to specify their chronology. The existence of a large number of Bronze Age metallurgical settlements in the Jandula, Rumberal and Guadiel valleys leads us to think, in the absence of archaeological confirmation, that these mines were worked during the Argaric Bronze Age, without specifying their chronology. It does seem clear that many of them would have been exploited at the same time during the Full Bronze Age. For example, lead isotopes taken from metallurgical samples (crucibles, metals and minerals) from the Peñalosa Argaric site and from several mines determined that this site was supplied by three mines at once: Polígono, José Martín Palacios and a third, as yet unknown. In the Iberian Peninsula, there are other examples of mines exploited before the Iron Age. Most of them are located in the regions of Asturias and León and include mines such as El Aramo and El Milagro (Asturias) and La Profunda (León) (Blas Cortina 2007/2008; Blas Cortina et al. 2013). To these it can also be added the Moçissos mines in Portugal (Hanning et al. 2010, 289), those in the southwest of the Iberian Peninsula (Hunt 2003), the Turquoise mines (Rafel et al. 2014) and the Solana del Bepo (Rafel et al. 2017) in Catalonia and Sa Mitja Lluna in Illa de Colom in Menorca (Islas Baleares) (Hunt et al. 2014).

The Eastern Sierra Morena Mining Territory: Organisation and Scale of Production

The exploitation of the rich mineral resources of the eastern valleys of the Sierra Morena has conditioned the settlement pattern over time. The first relevant evidence of occupation in the region dates back to the Chalcolithic period, with the presence of settlements related to the exploitation of copper minerals, such as the settlements of Siete Piedras, Cerro del Tambor (Baños de la Encina) (Nocete et al. 1987; Lizcano et al. 1990; Contreras 2000) or Castillo de Baños, where a cultural survival from the Copper Age to the Bronze Age is registered, with metallurgical remains that show the

relationship of this settlement with the mine of El Polígono, very close to it (Arboledas/Contreras 2010). Cerro del Pino, located in the valley of the Guadalquivir, far from the areas of extraction of the ore, should be highlighted. Its economy includes the process of transformation of copper, as evidenced by the findings of kiln vessels, raw ore, slag, and forge hammers (Moreno/Contreras 2010, fig. 2 a–d).

As analysed more extensively elsewhere (Contreras/Cámara 2002), for the time period since the threshold to the 2nd mill. BC an intense occupation of the eastern valleys of the Sierra Morena is observed, within the traditionally defined Argaric expansion (Molina et al. 1978), with the creation *ex novo* of numerous settlements such as Peñalosa, La Verónica, Cerro de las Obras, and others in the Rumberal Valley (Baños de la Encina), in which material remains of the copper-based metal production process have been documented (Contreras/Cámara 2002). These settlements occupy strategic positions to defend the copper seams in the territory and also to control the processing and distribution of the metal (Jaramillo 2005, 458, 474; Moreno/Contreras 2010) (fig. 2). In connection with these is a series of forts designed to improve the interconnection and control the natural passes from the valley of the Guadalquivir to the interior of the Sierra Morena. This increase in settlements and population in this area, uninhabited in earlier prehistoric times, can only be explained by the existence of copper and silver mining resources and by the intensification of their exploitation to produce quantities of metal that clearly exceed self-consumption (Contreras/Cámara 2002; Moreno/Contreras 2010). The surplus of the metal produced would be redistributed throughout the southeast, as shown by the lead isotope analyses carried out so far (Stos-Gale et al. 1999; Stos-Gale 2001; OXALID 2020; Hunt et al. 2011; Bartelheim et al. 2012, tab. 6; Murillo/Montero 2014; Murillo et al. 2015).

Therefore, the Upper Guadalquivir is a large mining territory where over approximately 400 years copper and silver seams were exploited and a great economic development was acquired, maintaining a high number of population and settlements thanks to the value of the metal resource.



Fig. 8. Peñalosa is the only Argaric settlement that shows the entire technological process of copper metal fabrication: a. mining hammers; b. copper ores; c. reduction pot; d. slags; e. crucible; f. pottery and stone moulds; g. objects.

In this region, there are some known Argaric settlements that give an idea of the dimension of this economic and political model. The excavation of the Argaric settlements of Peñalosa and El Cerro del Cueto/Castillo de Baños de la Encina, in the Rumblar valley, has allowed to document archaeologically the whole process of transformation of the ore into metal with an archaeometallurgical record rich in ore, slag, metal drops, crucibles, reduction pots, moulds and so on (fig. 8). The metallurgical work is documented inside the domestic units, in open areas, coexisting and sharing space with other productive activities (Moreno 2000; Contreras/Cámara 2002; Alarcón 2010) (fig. 9). This fact indicates the importance of metallurgical activity in the daily lives of the inhabitants of these settlements, the scale of production of which would exceed the needs of the site itself, as evidenced by the discovery in the latest excavation campaigns at Peñalosa of a dump with more than

100kg of metallurgical remains (slag, crucibles, reduction pots, etc.) (Contreras et al. 2014, 364–366; Moreno et al. 2017).

But the metallurgical process of transforming ore into metal would not always be carried out exclusively in these settlements. During recent field work in the eastern Sierra Morena, evidence of material culture of metallurgical work at the mine site has been documented. Specifically, in the mine of José Martín Palacios (Baños de la Encina) and in the annexed areas of three mines in the Jándula Valley (Candalares, Revuelta de Molínicos and Arroyo de la Grieta in Andújar), the existence of immature slag, pieces of crucibles and pot-furnaces, mining hammers and barquiform grinding stones has been confirmed (fig. 5). In none of these cases, with the exception of the Los Candalares mine, have possible structures been identified on the surface. In view of the dispersion of the material culture, they do not appear to fall within



Fig. 9. Distribution plan of archaeological remains of the House VI in Peñalosa.

the typology of settlements as documented in both valleys but could be classified as small spaces or multifunctional work zones dedicated primarily to the extraction and treatment of the ore (Arboledas et al. 2017). At the Mocissos mine (Portugal), evidences of metallurgical activity has also been found (Hanning et al. 2010, 289).

These models, along with the one registered in Catalonia (Rafel et al. 2014; 2017), seem to indicate the existence of small communities that are self-sufficient from local outcrops, which are sufficient for the demand of copper metal. These would be places occupied seasonally from late spring as they are in isolated mountain areas. In these areas, the ore would be treated to obtain the metal that would be transported to the villages. In this sense, many of the Copper and Bronze Age sites documented in the upper areas of the Sierra de Baza have also been interpreted as seasonally occupied sites associated with the exploitation of livestock, forestry and mining resources (Caballero et al. 2017, 348–351).

This pattern of copper mining in terms of technology (open pit, following the surface vein,

use of hard rock masses and possibly fire, etc.) is similar to that documented in the Sierra Morena. However, what is not comparable in this model is the scale of production, which here seems to be self-consumption, while in the eastern Sierra Morena it can be observed that since the Copper Age, but fundamentally in the Bronze Age, metal production of copper is carried out on a regional scale of great importance with numerous exploited mines and with settlements dedicated almost exclusively to the transformation of the mineral into metal, being able to propose a systematic, controlled and directed exploitation of the metal by some local elites and with a great mobility of the metal (Moreno et al. 2017).

This regional scale in the case of the Rumbalar Valley means that there are more than 15 settlements located less than 4km away and close to the main mines, which would make the existence of mining camps unnecessary, since a person could have moved between the settlement and the mine in a few hours. This does not rule out the possibility that at certain times people could have stayed in the mine for a few days, which would explain the



Fig. 10. Peñalosa: a. silver objects used as funerary goods; b. gold objects used as funerary goods; c. sword accessories that appeared in domestic context.

domestic archaeological remains found in the José Palacios mine (Baños de la Encina).

When we speak of a regional scale and intensity in the metal exploitation, a series of important social and political questions arise: who owns the resources? Who controls and how is the exploitation of the resources organised? Are there elites in political centres that organise production and redistribute the benefits of the metal? Or, on the contrary, would all members of the community have access to the resources?

In spite of the development of a systematic research project in the area, initiated in 1985 (Contreras et al. 1993), there is still much to learn about the social and political dimension of the

existing model in the Upper Guadalquivir (specifically, in the eastern foothills of Sierra Morena) during the Bronze Age. But the data determine that each village did not exclusively own a mine. As mentioned above, the minerals found in Peñalosa indicate, thanks to lead isotope analyses, that they come from three mines located within a short distance. Two of them have been located, associated with them there are large settlements such as Castillo de Baños for the mine in the Polygon or Cerro de los Castillejos for the mine in José Palacios (fig. 3–4). In other words, there is a chain in the exploitation of the mines and the distribution of the mineral to the metallurgical settlements, a perfectly organised system, with a series of elites in each settlement, who served this machinery and made the model work for about 400 years, providing metal and in exchange receiving grain and livestock. This model has been complicated by recent archaeological prospections carried out in the valleys of the Jandula and Yeguas rivers (Arboledas et al. 2017), where numerous mines and seams larger than those known in the Rumblar have been located. The association of these mines with the existing settlements in the area is still pending, and due to current administrative circumstances, it is very complicated to investigate, with difficult access to private properties.

This territorial framework is strongly hierarchical, with settlements of different sizes and with diverse functionalities (Contreras/Cámara 2002; Spanedda et al. 2004) as well as a ‘military’ component as witnessed by the forts located, especially that of Piedras Bermejas (Baños de la Encina, Jaén), where a copper axe with traces of use was located (Contreras et al. 2010, 100, fig. 102). Copper is a highly demanded resource at this time and its possession and exploitation may indicate the great economic and population development that this area had during the Bronze Age.

Apart from the territorial model, other data indicate the importance of the metal and its strength as an economic engine. Once again, the archaeological record of Peñalosa provides information on this subject. There are numerous indications of moulds for making metal ingots, all of them of similar dimensions and volumes, circular in the case of stone moulds (fig. 8f), some 20 of which

were recovered, and trapezoidal in the case of ceramic moulds (some 54 fragments, nine of them complete) (fig. 8f). In addition, nine metal ingots or cakes have been found (Contreras et al. 2010) (fig. 8g). This gives us a clear idea of the production of metal that has been produced for external demand, for exchange or tribute. This idea has been supported by the location of a dump pit outside the settlement of Peñalosa in its southern area, formed only by slag and remains of reduction vessels (Moreno et al. 2017). This metalliferous production is not reflected in the funeral remains of the inhabitants of Peñalosa, where only some tombs contain metal, clearly indicating that the producers of this metal have not had access to it to furnish their graves. It is not being produced for self-consumption and this production moves throughout the southeast controlled by an elite that organises distribution and redistributes the products obtained in exchange for the metal. In the case of Peñalosa, this is reflected in the existence of a family group, located on the acropolis of the settlement, a better defended place and occupying a privileged topographical position, with burials that show a higher social status due to their grave goods, a lower level of stress in their individuals and a diet richer in meat (Contreras et al. 1995; Cámara et al. 1996; Contreras et al. 2010).

This model of family elites organising metal production and distribution, recognisable in the Rumblar River Valley, shows the local scale of metal production. If the perspective is extended to the Alto Guadalquivir, there are other centres, of greater power, which possibly organised the territorial strategy of exploitation of the metal in the southern foothills of the Sierra Morena, centres with a cultural development already from the Chalcolithic, which built these settlements *ex novo* at the Rumblar and displaced population towards this zone to carry out the exploitation of the mineral. Of the known sites in the Upper Guadalquivir, the Cerro de las Eras del Alcázar in Úbeda and the Cerro del Alcázar in Baeza are noteworthy for their large size and high status (Zafra de la Torre 2006). This situation led to define the Grupo Argárico del Alto Guadalquivir (Contreras 2000) as a hierarchical social formation, in which social differentiation is becoming more and more acute,

with a large socioeconomic base for an agricultural type strengthened by the exploitation of copper minerals and native silver from the southern foothills of the Sierra Morena (fig. 10). The exploitation of this resource was so intensive that it possibly collapsed due to over-exploitation, which led to the disappearance of the entire population of the Rumblar River Valley at one point, abandoning all these villages and forts.

The importance of the scale of copper metal production in the eastern Sierra Morena has also been highlighted by another research team (Lull et al. 2010a). For them, with the culture of El Argar a completely new economic system is emerging in the Iberian Peninsula, in which the distance between producers and consumers is increasing and restructuring itself over its almost 700 years of development to the point of requiring a political organisation that can be defined as a state (Lull et al. 2010b). They propose the Argaric world as one of the first European states, controlling a wide territory, which they even project towards La Mancha with the Cerro de la Encantada as the main settlement, including the control of the mines of the eastern Sierra Morena from the central foci of Almería and Murcia.

Conclusions

The main results are:

- The eastern Sierra Morena region appears as one of the main mining areas during the Bronze Age, with the location of 21 prehistoric mines specialised in the exploitation of copper ore.
- Large-scale production of copper is documented in the archaeological record of Peñalosa, where reduction and smelting work can be seen in practically all areas of the settlement. Its importance is reflected in the appearance of a dump outside the settlement, possibly made up exclusively of slag, fragments of reduction and smelting crucibles and remains of reduction vessels, as well as stone and ceramic moulds used to make copper ingots and cakes, some of which have been recovered during the excavation.

- This production takes shape in a hierarchically structured territory, with settlements of different functions: control of ore extraction, metallurgical transformation, ‘military’ forts and agricultural settlements. This pattern of settlement might be the result of a movement of population to exploit mining resources.
- Control of production by the elite of the Upper Guadalquivir Argaric group. The lead isotopes indicate the mobility of this metal towards the southeast and possibly towards other areas. According to our research, it is not possible to consider this area as a metallurgical focus of the Argaric state controlled from Almería or Murcia as proposed by some authors.

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Bibliography

- Alarcón 2010*: E. Alarcón, Continuidad y cambio social. Las actividades de mantenimiento en el poblado argárico de Peñalosa (Baños de la Encina, Jaén) (Granada 2010).
- Ambert et al. 2009*: P. Ambert/V. Figueroa/J. L. Guendon/V. Klemm/M. Laroche/S. Rovira/C. Strahm, The Copper Mines of Cabrières (Hérault) in Southern France and the Chalcolithic Metallurgy. In: T. Kienlin/B. Roberts (eds.), *Metal and Societies. Studies in Honour of Barbara Ottaway*. Universitätsforschungen zur Prähistorischen Archäologie 169 (Bonn 2009) 285–295.
- Aranda et al. 2015*: G. Aranda/S. Montón/M. Sánchez, *The Archaeology of Bronze Age Iberia. Argaric Societies* (New York 2015).
- Arboledas/Alarcón 2018*: L. Arboledas/E. Alarcón, Redefining the Role of Metal Production During the Bronze Age of South-Eastern Iberia. *The Mines of Eastern Sierra Morena. Documenta Praehistorica* 45, 2018, 138–153.
- Arboledas/Contreras 2010*: L. Arboledas/F. Contreras, La mina del Polígono o Contraminas (Baños de la Encina, Jaén). Evidencias de la explotación de mineral de cobre en la antigüedad. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 20, 2010, 355–379.
- Arboledas et al. 2015*: L. Arboledas/E. Alarcón/F. Contreras/A. Moreno/J. J. Padilla/A. Mora, La mina de José Martín Palacios-Doña Eva (Baños de la Encina, Jaén). La primera explotación minera de la Edad del Bronce documentada en el sureste de peninsular. *Trabajos de Prehistoria* 72.2, 2015, 145–162. DOI: 10.3989/tp.2015.12149.
- Arboledas et al. 2017*: L. Arboledas/C. Bashore/E. Alarcón/F. Contreras/A. Moreno/J. J. Padilla, Bronze Age Mining in Southeast Spain. New Copper Mines from the Jandula and Yeguas Valleys, Sierra Morena. In: I. Montero/A. Perea (eds.), *Archaeometallurgy in Europe IV. Colección Bibliotheca Praehistorica Hispana* 33 (Madrid 2017) 49–63.
- Arboledas et al. in press*: L. Arboledas/E. Alarcón/F. Contreras/A. Moreno/J. J. Fernández/C. Bashore, Prospección arqueominera selectiva e intensiva en la cuenca media/alta del río Jándula (Jaén). *Anuario Arqueológico de Andalucía* 2014, in press.
- Azcarate 1972*: J. E. Azcarate, Los sistemas de fractura filononianas en los Distritos de Linares-La Carolina. Su establecimiento y las reactivaciones posteriores de su capacidad mineralífera. In: *Actas de las Jornadas Minero-Metalúrgicas IV Nacionales y II Internacionales* (Cartagena, 17 a 22 de mayo 1971) (Madrid 1972) 553–570.

- Barge/Ancel 2003*: H. Barge/B. Ancel, Exploitation d'une Mine de cuivre préhistorique. Les Clausis à Saint-Vérán. *Archaeologia hors serie* 2003, 46–49.
- Bartelheim et al. 2012*: M. Bartelheim/F. Contreras/A. Moreno/M. Murillo/E. Pernicka, The Silver of the South Iberian El Argar Culture. A First Look into Production and Distribution. *Trabajos de Prehistoria* 69.2, 2012, 293–309.
- Bashore 2013*: C. Bashore, La metalurgia argárica en la cuenca de Guadix-Baza. *Arqueología y Territorio* 10, 2013, 27–40.
- Bashore et al. 2014*: C. Bashore/A. Moreno/F. Contreras, La metalurgia argárica. Nuevas aportaciones. Los yacimientos de Castellón Alto (Galera) y La Terrera del Reloj (Dehesas de Guadix). In: D. Juanes Barber/C. Roldán García (eds.), *Actas del X Congreso Ibérico de Arqueometría (Castellón 2014)* 304–312.
- Blanco/Rothenberg 1981*: A. Blanco/B. Rothenberg, Exploración arqueometalúrgica de Huelva (Barcelona 1981).
- Blas Cortina 2007/2008*: M. A. de Blas Cortina, Minería prehistórica del cobre en el reborde septentrional de los Picos de Europa. Las olvidadas labores “El Milagro” (Onís, Asturias). *Veleia* 24–25, 2007/2008, 723–753.
- Blas Cortina 2014*: M. A. de Blas Cortina, El laboreo del cobre en la Sierra del Aramo (Asturias) como referente cardinal de la minería prehistórica en la región cantábrica. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 24, 2014, 45–84.
- Blas Cortina et al. 2013*: M. A. de Blas Cortina/F. Rodríguez/M. Suárez, De las labores subterráneas a las actividades metalúrgicas en el exterior. *Investigaciones 2007–2012 en las minas de cobre prehistóricas de la Sierra del Aramo (“La Campa les Mines”, Concejo de Riosa). Excavaciones arqueológicas en Asturias 2007–2012*, 2013, 169–187.
- Bourgarit et al. 2010*: D. Bourgarit/P. Rostan/L. Carozza/B. Mille/G. Artioli, Vingt ans de recherches à Saint-Vérán, Hautes Alpes. État des connaissances de l'activité de production de cuivre à l'âge du Bronze ancien. *Trabajos de Prehistoria* 67.2, 2010, 269–285.
- Caballero et al. 2017*: A. Caballero/L. García-Pulido/F. Contreras/L. Arboledas/E. Alarcón/J. M. Martín/A. M. Adroher, Evolución del paisaje minero en las Sierra Andaluzas orientales que orlan los Altiplanos de Baza y Guadix. Desde los inicios hasta la Edad Moderna. In: L. García/L. Arboledas/E. Alarcón/F. Contreras (eds.), *Presente y futuro de los paisajes mineros del pasado. Estudios sobre la minería, metalurgia y poblamiento. Universidad de Granada (Granada 2017)* 341–354.
- Calvert 1903*: A. F. Calvert, *Impressions of Spain* (London 1903), last updated 11.09.2008, <<https://archive.org/details/impressionsofspa00calvrch>> (last access 14.06.2021).
- Cámara et al. 1996*: J. Cámara/F. Contreras/C. Pérez/R. Lizcano, Enterramientos y diferenciación social, II. La problemática de la Edad del Bronce en el Alto Guadalquivir. *Trabajos de Prehistoria* 53.1, 1996, 91–108.
- Carozza 2005*: L. Carozza, La fin du Néolithique et les débuts de la métallurgie en Languedoc central. La mutation des habitats du Puech Haut à Paulhan (Hérault) entre 3200 et 2200 av. J.-C. *Recherches en Archéologie Préventive* 3 (Toulouse 2005).
- Carrión 2000*: F. Carrión, La piedra trabajada de Peñalosa. In: F. Contreras (ed.), *Proyecto Peñalosa. Análisis Histórico de las Comunidades de la Edad del Bronce del piedemonte meridional de Sierra Morena y Depresión Linares-Bailen. Arqueología Monográficas* 10 (Sevilla 2000) 141–158.
- Contreras 2000*: F. Contreras, *Proyecto Peñalosa. Análisis histórico de las comunidades de la Edad del Bronce del Piedemonte Meridional de Sierra Morena y Depresión Linares-Bailen. Arqueología Monografías* 10 (Sevilla 2000).
- Contreras/Cámara 2002*: F. Contreras/J. A. Cámara, La jerarquización social en la Edad del Bronce del Alto Guadalquivir (España). El poblado de Peñalosa (Baños de la Encina, Jaén). *British Archaeological Reports. International Series* 1025 (Oxford 2002).

- Contreras/Dueñas 2010*: F. Contreras/J. Dueñas (eds.), La minería y la metalurgia en el Alto Guadalquivir. Desde sus orígenes hasta nuestros días (Jaén 2010).
- Contreras et al. 1993*: F. Contreras/F. Nocete/R. Sánchez/R. Lizcano/C. Pçerez/J. A. Cámara/S. Moya, Análisis histórico de las comunidades de la Edad del Bronce en la Depresión Linares-Bailén y las estribaciones meridionales de Sierra Morena. In: Investigaciones arqueológicas en Andalucía (1985–1992). Proyectos (Huelva 1993) 429–440.
- Contreras et al. 1995*: F. Contreras/J. A. Cámara/R. Lizcano/C. Pérez/B. Robedo/G. Trancho, Enterramientos y diferenciación social, I. El registro funerario del yacimiento de la edad del Bronce de Peñalosa (Baños de la Encina, Jaén). Trabajos de Prehistoria 52.1, 1995, 87–108.
- Contreras et al. 2000*: F. Contreras/J. A. Cámara/G. Trancho/B. Robledo, El poblado de la Edad del Bronce de Peñalosa (Baños de la Encina, Jaén), 14. La necrópolis. In: F. Contreras (ed.), Proyecto Peñalosa. Análisis Histórico de las Comunidades de la Edad del Bronce del piedemonte meridional de Sierra Morena y Depresión Linares-Bailen. Arqueología Monografías 10 (Sevilla 2000) 287–324.
- Contreras et al. 2005*: F. Contreras/J. Dueñas/A. Jaramillo/A. Moreno/L. Arboledas/D. Campos/J. A. García/A. Pérez, Prospección arqueometalúrgica en la cuenca alta del río Rumblar. Anuario Arqueológico de Andalucía 2003.II, 2005, 22–36.
- Contreras et al. 2010*: F. Contreras/A. Moreno/J. A. Cámara, Los inicios de la minería. La explotación del mineral de cobre. In: F. Contreras/J. Dueñas (eds.), La minería y la metalurgia en el Alto Guadalquivir. Desde sus orígenes hasta nuestros días (Jaén 2010) 43–122.
- Contreras et al. 2014*: F. Contreras/A. Moreno/L. Arboledas/E. Alarcón/A. Mora/J. J. Fernández/A. García, Un poblado de la Edad del Bronce que tiene mucho que decir, Peñalosa. Últimas novedades. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 24, 2014, 347–390
- Delgado et al. 2014*: S. Delgado/N. Escanilla/R. Risch, Mazas ocultas. Rastros de minería prehistórica en el Cerro Minado de Huércal-Overa (Almería). Cuadernos Prehistoria y Arqueología de la Universidad de Granada 24, 2014, 13–44.
- Domergue 1987*: C. Domergue, Catálogo de minas y fundiciones antiguas de la Península Ibérica (Madrid 1987).
- Escanilla 2016*: N. Escanilla, Recursos minerales de cobre y su explotación prehistórica en el sudeste peninsular. El valle del Guadalentín (PhD-Thesis Universidad Autónoma de Barcelona 2016).
- Escanilla/Delgado 2015*: N. Escanilla/S. Delgado-Raack, Minería prehistórica del cobre (3100–1550 cal ane) en el Levante murciano. In: José María López Ballesta (coord.), Minería y metalurgia en el Mediterráneo y su periferia oceánica. PHICARIA, III Encuentros Internacionales del Mediterráneo (Mazarrón 2015) 77–99.
- García Asensio 1910*: E. García Asensio, Historia de la villa de Huércal-Overa y su comarca. Precedida de un estudio físico-geológico de la cuenca del río Almanzora y terminando con la descripción política actual (Murcia 1910).
- Gilman 1987*: A. Gilman, El análisis de clase en la Prehistoria del Sureste. Trabajos de Prehistoria 44.1, 1987, 27–34.
- Hanning et al. 2010*: E. Hanning/R. Gauß/G. Goldenberg, Metal for Zambujal. Experimentally Reconstructing a 5000-Year-Old Technology. Trabajos de Prehistoria 67.2, 2010, 287–304.
- Hunt 2003*: M. A. Hunt, Prehistoric Mining and Metallurgy in South-West Iberian Peninsula. British Archaeological Reports. International Series 1188 (Oxford 2003).
- Hunt et al. 2011*: M. A. Hunt/F. Contreras/L. Arboledas, La procedencia de los recursos minerales metálicos en el poblado de la Edad de Bronce de Peñalosa (Baños de la Encina, Jaén). Resultados de análisis de isótopos de plomo. In: J. M. Mata Perelló/L. Torró i Abat/M. N. Fuentes Prieto/A. Neira Campo/O. Puche

- Riart (eds.), *Actas del quinto congreso internacional sobre minería y metalurgia históricas en el suroeste europeo* (León – 2008). Libro en homenaje a Claude Domergue (Madrid 2011) 195–206.
- Hunt et al. 2014*: M. A. Hunt/M. Lull/L. Perelló/B. Salvà, Aprovechamiento de recursos cupríferos en la Edad del Bronce de Menorca. La mina de Sa Mitja Lluna (Illa de Colom). *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 24, 2014, 45–109.
- IGME 1977*: Instituto Geológico y Minero de España, Mapa geológico de España, Linares (905 (19–36)), E. 1:50.000 (Madrid 1977).
- Jaramillo 2005*: A. Jaramillo, Recursos y materias primas en la Edad del Bronce del Alto Guadalquivir, medioambiente y el registro arqueológico en la cuenca del río Rumblar (PhD-Thesis Universidad de Granada 2005).
- Jovanović 1982*: B. Jovanović, Rudna Glava (Belgrade 1982).
- Lizcano et al. 1990*: R. Lizcano/F. Nocete/C. Pérez/F. Contreras/M. Sánchez, Prospección arqueológica sistemática en la cuenca alta del río Rumblar. *Anuario Arqueológico de Andalucía* 1987.II, 1990, 51–59.
- Lull 1983*: V. Lull, La cultura del argar. Un modelo para el estudio de las formaciones económico-sociales prehistóricas (Madrid 1983).
- Lull et al. 2010a*: V. Lull/R. Micó/C. Rihuete/R. Risch, Metal and Social Relations of Production in the 3rd and 2nd Millennia BCE in the Southeast of the Iberian Peninsula. *Trabajos de Prehistoria* 67.2, 2010, 323–347.
- Lull et al. 2010b*: V. Lull/R. Micó/C. Rihuete/R. Risch, Las relaciones políticas y económicas de El Argar. Menga. *Revista de Prehistoria de Andalucía* 1, 2010, 11–36.
- Molina et al. 1986*: F. Molina/P. Aguayo/F. Fresneda/F. Contreras, Nuevas investigaciones en yacimientos de la Edad del Bronce en Granada. In: Consejería de Cultura (eds.), *Homenaje a Luis Siret (1934–1984)* (Sevilla 1986) 353–360.
- Molina et al. 1978*: F. Molina/L. Sáez/P. Aguayo/F. de la Torre/T. Nájera, La Edad del Bronce en el Alto Guadalquivir. Excavaciones en Úbeda. *Boletín del Instituto de Estudios Giennenses* 95, 1978, 37–58.
- Montero/Murillo 2010*: I. Montero/M. Murillo, La producción metalúrgica en las sociedades argáricas y sus implicaciones sociales. Una propuesta de investigación. Menga. *Revista de Prehistoria de Andalucía* 1, 2010, 37–51.
- Moreno 1993*: A. Moreno, El Malagón. Un asentamiento de la Edad del Cobre en el Pasillo de Cúllar-Chirivel (PhD-Thesis Universidad de Granada 1993).
- Moreno 2000*: A. Moreno, La metalurgia de Peñalosa/Peñalosa Metallurgy. In: F. Contreras Cortés (coord.), *Análisis histórico de las comunidades de la Edad del Bronce del Piedemonte meridional de Sierra Morena y Depresión Linares-Bailén. Proyecto Peñalosa. Arqueología. Monografías 10* (Sevilla 2000) 167–222.
- Moreno/Contreras 2010*: A. Moreno/F. Contreras, La organización social de la producción metalúrgica en las sociedades argáricas. El poblado de Peñalosa. Menga. *Revista de prehistoria de Andalucía* 1, 2010, 53–76.
- Moreno et al. 2010*: A. Moreno/F. Contreras/M. Renzi/S. Rovira/H. Cortés, Estudio preliminar de las escorias y escorificaciones del yacimiento metalúrgico de la Edad del Bronce de Peñalosa (Baños de la Encina, Jaén). *Trabajos de Prehistoria* 67.2, 2010, 305–322.
- Moreno et al. 2017*: A. Moreno/S. Rovira/F. Contreras/M. Renzi/L. Arboledas/E. Alarcón/A. Mora/A. García, New Data on Scale Production of Copper in the Culture of the El Argar. The Dumping Ground for Peñalosa (Baños de la Encina, Jaén). In: I. Montero/A. Perea (eds.), *Archaeometallurgy in Europe IV. Bibliotheca Praehistorica Hispana* 33 (Madrid 2017) 65–78.
- Murillo/Montero 2014*: M. Murillo/I. Montero, Producción y distribución de la plata en la sociedad argárica y en los asentamientos orientalizantes. Una aproximación desde el análisis de los isótopos de plomo. In: E. García (ed.), *II Congreso de Prehistoria de Andalucía, Movilidad, contacto y cambio* (Sevilla 2014) 159–176.

- Murillo et al. 2015*: M. Murillo/I. Montero/G. Aranda, An Insight into the Organisation of Metal Production in the Argaric Society. *Journal Archaeological Science. Reports* 2, 2015, 141–155.
- Nocete et al. 1987*: F. Nocete/M. Sánchez/R. Lizcano/F. Contreras, Prospección arqueológica sistemática en la cuenca baja/media-alta del río Rumbalar. *Anuario Arqueológico de Andalucía* 1986.II, 1987, 75–78.
- O'Brien 2004*: W. O'Brien, Ross Island. Mining, Metal and Society in Early Ireland. *Bronze Age Studies* 6 (Galway 2004).
- OXALID 2020*: Oxford Archaeological Lead Isotope Database from the Isotrace Laboratory, <<http://oxalid.arch.ox.ac.uk/>> (last access 18.02.2020).
- Rafel et al. 2014*: N. Rafel/I. Montero/I. Soriano/M. A. Hunt/X. L. Armada, Nuevos datos sobre la minería pre y protohistórica en Cataluña. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 24, 2014, 147–166.
- Rafel et al. 2017*: N. Rafel/I. Soriano/S. Delgado-Raack, A Prehistoric Copper Mine in the North-East of the Iberian Peninsula. Solana del Bepo (Ulldemolins, Tarragona). *Revista d'Arqueologia de Ponent. Extres* 2 (Lleida 2017).
- Risch 1997*: R. Risch, Recursos naturales y sistemas de producción en el sudeste de la Península Ibérica entre 3000 y 1000 ANE (Barcelona 1997).
- Risch et al. 2002*: R. Risch/F. Martínez/J. F. Gibaja, Recursos naturales, medios de producción y explotación social. Un análisis económico de la industria lítica de Fuente Álamo (Almería), 2250–1400 antes de nuestra era. *Iberia Archaeologica* 3 (Mainz am Rhein 2002).
- Rothenberg et al. 1988*: B. Rothenberg/F. Carrión/A. Moreno/V. Mérida, A Prehistory Copper Mine and Smelter in South-East Andalusia (Spain). First Discovery by IAMS Survey Team. *Institute of Archaeo-Metallurgical Studies. Newsletter* 13 (London 1988) 1–5.
- Sánchez Quirantes et al. 2014*: L. Sánchez-Quirantes/A. M. Adroher/A. Caballero, Minería metálica durante la Edad del Cobre en Sierra de Baza (Granada). Los Cortijillos como estudio de caso. In: L. J. García Pulido/F. Contreras Cortés/L. Arboledas Martínez/E. Alarcón García/A. Moreno Onorato/A. M. Adroher Auroux/J. M. Martín Civantos (eds.), *Preactas del VIII Congreso sobre minería y metalurgia históricas en el sudoeste europeo* (Granada 2014) 25–27.
- Siret/Siret 1888*: L. Siret/H. Siret, Les Premières Âges du Métal dans le Sudest de l'Espagne (Bruxelles 1888).
- Spanedda et al. 2004*: L. Spanedda/R. Lizcano/J. A. Cámara/F. Contreras, El poblado de Sevilleja y la Edad del Bronce en el valle del Rumbalar. In: R. García-Huerta/J. Morales (eds.), *La Península Ibérica en el II milenio A.C. Poblados y fortificaciones. Humanidades* 77 (Cuenca 2004).
- Stos-Gale 2001*: S. Stos-Gale, The Development of Spanish Metallurgy and Copper Circulation in Prehistoric Southern Spain. In: B. Gómez/M. A. Respaldiza/M. L. Pardo (eds.), *III Congreso Nacional de Arqueometría* (Sevilla 2001) 445–456.
- Stos-Gale et al. 1999*: S. Stos-Gale/M. A. Hunt/N. H. Gale, Análisis elemental de Isótopos de Plomo de objetos metálicos de Gatas. In: P. V. Castro/R. Chapman/S. Gili/V. Lull/R. Mico/C. Rihuete/R. Risch/M. E. Sanahuja (eds.), *Proyecto Gatas 2. La dinámica arqueológica de la ocupación prehistórica. Arqueología Monografías* (Sevilla 1999) 347–358.
- Tamain 1972*: G. Tamain, Recherches géologiques et minières en Sierra Morena orientale (Espagne) (Paris 1972).
- Timberlake 2003*: S. Timberlake, Excavations on Copa Hill, Cwmystwyth (1986–1999). An Early Bronze Age Copper Mine Within the Uplands of Central Wales. *British Archaeological Reports. British Series* 348 (Oxford 2003).
- Zafra de la Torre 2006*: N. Zafra de la Torre, De los campamentos nómadas a las aldeas campesinas. La provincia de Jaén en la Prehistoria (Jaén 2006).

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The First Bronzes in El Argar

An Approach to the Production and Origin of the Metal

Keywords: bronze, lead isotope analysis, El Argar culture, provenance studies, archaeometallurgy, Late Prehistory

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Abstract

Contrary to copper ore resources, tin is scarce in southeastern Iberia. However, tin is essential to produce the copper/tin alloy called tin bronze. The first use of this alloy in the so-called El Argar Culture is detected in its later phases (from 1900–1800 calBC), although it never constituted the predominant alloy. The absence of metallurgical debris related to bronze smelting limits our understanding on how the alloy was obtained and if cassiterite was co-smelted with copper ores in the Argaric territory or whether metallic tin bronzes were imported to El Argar from regions further away. Tin, as an external resource, would have been exchanged or traded, but there is also the possibility that finished bronze objects were imported as well. Some differential pattern in the

presence/absence of arsenic in the composition of metal objects could reflect a double strategy, suggesting that local production of tin bronzes usually contains some arsenic, but tin bronzes without any arsenic could have come from other Iberian regions, or at least that different copper ores for the production of arsenical copper and tin bronze were used. This hypothesis is tested using the available lead isotopes analyses.

Introduction

Intentional copper and tin alloy (bronze) is identified for the first time in metal objects from the end of the 3rd mill. BC in northwestern Europe, a region with abundant copper and tin mineral resources, but the adoption and full use of this alloy spread towards central, eastern and southern Europe in a chronological gradient (Pare 2000, fig. 1.14, 26). Its discovery and expansion can be explained by the presence/absence of tin mineral and the trade networks capable of distributing it (Earle et al. 2015). We observe a similar situation on the Iberian Peninsula, with knowledge of alloying arriving first in the northern territories and later in the south (Fernández-Miranda et al. 1995). Although some copper-tin ores could produce a natural tin bronze alloy, (Rovira Llorens/Montero Ruiz 2003; Radivojevic et al. 2013) most of the tin bronzes in the European Bronze Age are considered intentional alloys, supported in the case of the Iberian Peninsula by the identification of co-smelting of copper ores with cassiterite (Rovira Llorens 2007).

Between 2250 and 1550 calBC, the southeastern Iberian Peninsula saw the development of the so-called El Argar culture, which has one of the best

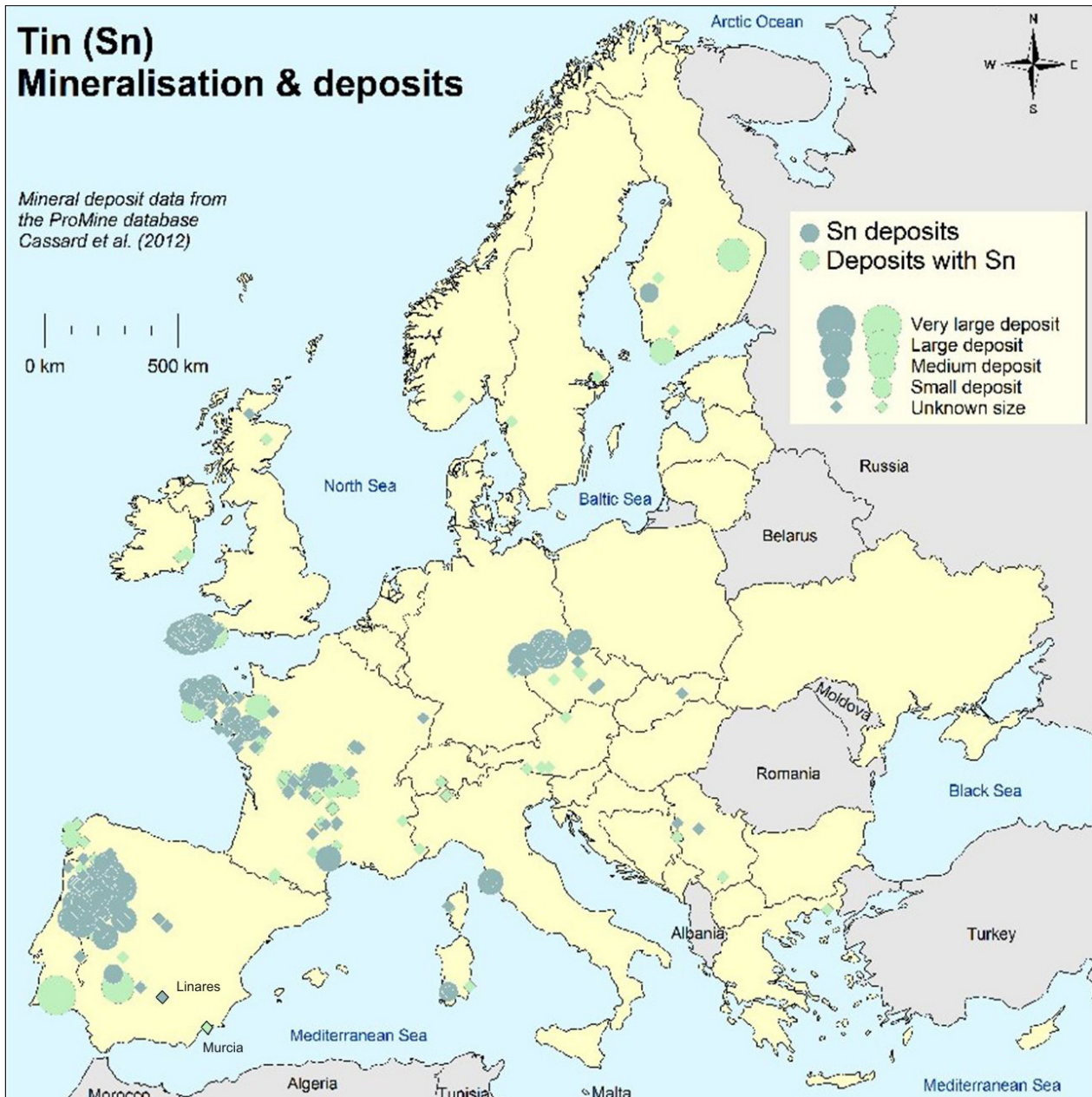


Fig. 1. Map of Europe with the tin ores' distribution with reference to the resources of the southeastern Iberian Peninsula (modified from the original Mineral deposit data from ProMine database by Cassard et al. 2012).

Bronze Age archaeological records (Lull 1983; Aranda et al. 2015). Archaeometallurgical studies have confirmed that the first Argaric tin bronzes appeared at some point of time during the culture's chronological development (Siret/Siret 1890; Montero Ruiz 1994), although alloying with tin was never in the majority, nor did it ever completely replace the arsenical copper that had been typical since the Chalcolithic (Montero Ruiz et al. 2019).

The region is lacking tin ore, a key factor for understanding how the first bronzes were

produced. Maps, such as in fig. 1, show there was some tin in Cartagena (Punta de Calnegre) and Loma del Bas in the Murcia region (see also IGME MGD 50 – Hoja 975 Puerto Lumbreras). However, according to Escanilla (2016, 69), the cassiterite is found mixed with iron in invisible submillimetric fractions and, due to its modern unprofitability, the viability of its exploitation in antiquity has always been questioned. Another area in which cassiterite has been identified is the mining district of Linares, although geological mentions of

it are very vague; they include those quoted by Calderón (1910, 290) or Arboledas et al. (2010) that indicate its association with the granodioritic rocks of the mining district.

Using halberds as guiding fossil, it has been suggested that the first tin bronzes in El Argar appeared after 1800 calBC (Montero Ruiz 1999), in other words, in the later phases of its historical development. Recent studies of the chronology of the halberds have confirmed that this weapon was no longer in use after 1800 calBC and was replaced by swords, more than 50cm long, in grave goods (Lull et al. 2010a; 2017).¹ Moreover, all the halberds analysed, regardless of the analytical technique or laboratory used, were shown to have been made of arsenical copper (Montero Ruiz et al. 2019). In other words, there were no Argaric-type halberds made of tin bronze. As an example of the slow adoption of tin alloying, the case of the swords can be mentioned, whose chronological development covers the period between 1800 and 1550 calBC. Only 30% of Argaric swords have tin in their composition (Montero Ruiz et al. 2019, 20).

Nevertheless, some grave goods with halberds also contained tin bronze daggers.² Although tin alloying was never used for halberds, there were contemporary tin bronze objects. The date of these first tin bronzes is earlier than the 1800 calBC reference point (Montero Ruiz et al. 2019).

One possible explanation for this situation is that these first tin bronze objects could have been imported, while the halberds, a type predominant in the Argaric area, would have been locally produced (Montero Ruiz et al. 2020). The production of metals alloyed with tin would only have occurred at a later time in El Argar territory. It is difficult to identify imported objects based on their typology. This is due, for example, to the typological similarity of the daggers with rivets on the Iberian Peninsula (Brandherm 2003) and to the absence of distinctive formal features in



Fig. 2. Grave goods in the Fuente Alamo burial number 1 with a halberd and a short sword with decorated blade. Original drawing by Louis Siret kept at the Spanish National Archaeological Museum Archive (1944/45/FD01363), <<http://ceres.mcu.es/pages/AdvancedSearch?Museo=MAN>> (last access 09.10.2021).

other frequent types of metals, such as awls or open rings. However, there are a few objects with clear indications that metal was imported into El Argar and therefore this alternative explanation must be considered. The most obvious cases are the daggers with decorated blades related to north-alpine types (Brandherm 2003, n° 946, 1259), such as the example from T880 at El Argar or the bronze dagger from Tomb 1 at Fuente Alamo, the latter uniquely associated with a copper halberd (*fig. 2*).

We recently proposed that to confirm the hypothesis of some tin bronze objects having been imported, we have to resort to lead isotope analysis to obtain data that would allow evaluating the origin of the metal (Montero Ruiz et al. 2019, 23). We also observed that in the composition of the bronzes it is possible to differentiate two groups according to the presence or absence of arsenic. Such a study of origin should evaluate whether this feature could serve to differentiate foreign and local productions, although the presence of

¹ Tomb n° 1 of Rincón de Almendricos and tomb n° 994 of El Argar are the only ones that combine a sword and a halberd in the same tomb. Both swords are short types of 31.8 and 32.1cm length respectively. The sword from Rincón de Almendricos has an unusual decoration on its blade.

² This association has been identified in Tomb 1 at Fuente Alamo, Tomb 62 at El Oficio and Tomb 3 at Los Cipreses (Montero Ruiz et al. 2019).

arsenic is not necessarily an exclusive indicator of local production, as arsenical copper is common in quite a few areas on the Iberian Peninsula. In contrast, the finds of pure copper and tin bronzes without arsenic suggest manufacture with mineral resources not normally used in the area, as pure copper is exceptional in all Chalcolithic and Argaric metallurgy (Junghans et al. 1960; 1968; Rovira Llorens et al. 1997; Hook et al. 1991). Escanilla (2017) hypothesised that some sites in Murcia, such as Agua Amarga and La Ciñuela, used local iron- and copper-bearing ores, although they were mixed with copper arsenates from neighbouring areas. However, the author also proposed that the use of those minerals ended in the Argaric period. It should be reminded that, although the most suitable ores were selected, the presence of arsenic is associated with the processed copper ores and is, therefore, the result of natural alloying (Rovira Llorens/Montero Ruiz 2018; Murillo-Barroso et al. 2020), rather than intentional alloying of copper and tin (Rovira Llorens 2007). The relative frequency of metals alloyed with tin that also contain significant amounts of arsenic, suggests that tin was not a substitute for arsenic in the alloying (Montero Ruiz 1994).

We currently do not have any archaeological data that would confirm bronze production in the Argaric area. At Peñalosa, where metallurgy remains are abundant and some bronze objects have been found, no vestiges have yet been identified that would confirm a co-reduction of copper and tin ore, nor the remains of bronze production (Moreno Onorato/Contreras Cortés 2015, 318). Only the crucibles from the El Argar archaeological site prove that at some time bronze objects were cast there, although we are unable to determine whether this corresponds to the production of new metal or to recycling (Mongiatti/Montero Ruiz 2020). The option of natural tin bronze alloy in the region cannot be totally excluded as some copper-tin ores are described in Sierra de Cartagena, Sierra Tercia and Cerro de la Mina de Siscar (Rovira Llorens/Montero Ruiz 2003), some of these ores containing not only tin but arsenic. However, these tin bearing ores are not as abundant as copper arsenates in the region and, as described by Rovira and Montero (2003), the oxidising copper

smelting conditions typical of this metallurgy usually do not produce tin bronzes, but occasionally could obtain tin in very low proportion (< 2% Sn).

Lead Isotope Analysis

On the following pages an initial evaluation of the origin of the tin bronzes based on the information provided by lead isotope analysis is presented. The interpretation of the results is not exempt from difficulties, for example regarding the practice of metal recycling or the representativity of the comparative geological information (Pernicka 2014). However, we will focus mainly on confirming or not whether tin bronzes without arsenic (< 0.2% As) could be imported objects (*fig. 3*).

The basic data and arguments are as follows:

- (1) Geological information. The data used is compiled in the archaeometallurgy of the Iberian Peninsula Project database (Rovira Llorens/Montero Ruiz 2018) consisting of 1289 ore sample analyses. The geographical distribution of the samples and reference to the publications from which each analysis is taken is detailed in Montero Ruiz (2018, Table 1). As new information, and given its relation to our study area, we can add the copper minerals from the Vera Basin published in Murillo-Barroso et al. (2019).
- (2) Archaeological information. Although the interest of this article focuses on tin bronzes, in some of the comparisons it is necessary to refer to copper or arsenical copper objects. The data available are those published by Stos-Gale et al. (1999), complemented by information from the OXALID database, the metals published by Murillo-Barroso et al. (2015) and those resulting from the HAR2017–82685–R project. The last of these correspond mainly to the Siret Collection at the British Museum (*table 1*). To this list, two pieces from Puebla de Don Fadrique (Granada) now at the Royal Academy of the History and studied by Álvarez Penanes (2016) can be added. The metallurgical and mineral remains from Peñalosa are not included (Hunt Ortiz et al. 2011). We are aware of other ongoing investigations,

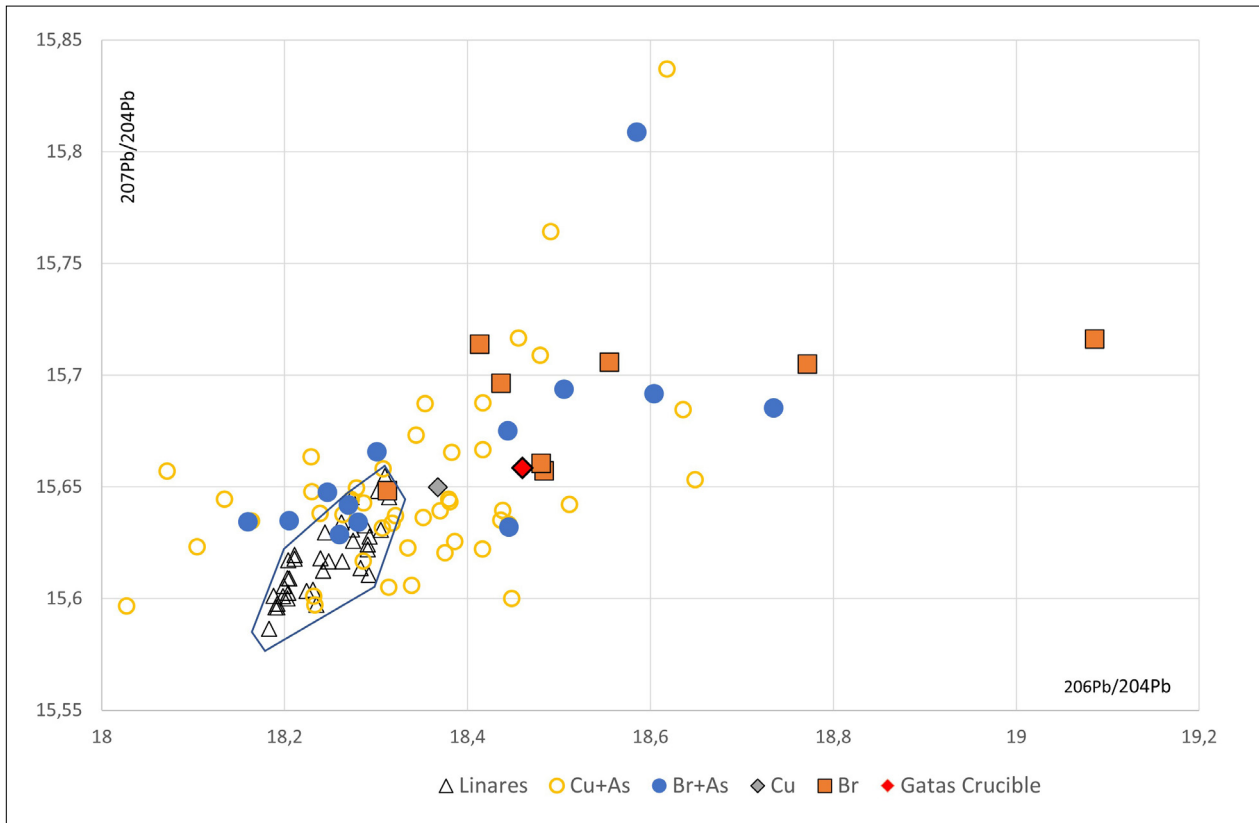


Fig. 3. General distribution of Lead Isotope Analysis (LIA) made of El Argar metal objects by type of alloy (Cu = pure copper; Cu+As = copper with arsenic >0.2 %; Br = tin bronze without arsenic; Br+As = tin bronze with As >0.2%) and with reference to the Linares mining district.

but their data has not yet been published and cannot be included in this initial study. The sample consists of 70 objects of which 20 are classified as tin bronzes (> 1% tin), 49 are copper with arsenic (> 0.2% As) and one can be included in the pure copper category (the dagger from Tomb 18 at El Cerro de la Encina with 0.14% As). Of the tin bronzes, only seven contain arsenic in a proportion lower than 0.2% and are classified as tin bronze without arsenic. Due to some of the objects being fully corroded or showing a thick corrosion layer, some surface measurements can be distorted from the original composition. In the Argaric area, arsenic surface enrichments are frequent, but at the same time tin could be underestimated on surface analyses (Montero Ruiz et al. 2019, 11). So, the arsenic threshold used in tin bronzes to classify each item is somehow arbitrary but as a first approach to this question, it helps to classify the objects into two groups in order to compare lead isotope data.

(3) The least likely recycled objects (which therefore more faithfully reflect their metal provenance) are daggers, swords and halberds. This is the opinion of various authors regarding the metallurgy of the Early Bronze Age (Ling et al. 2019). In the case of the Argaric daggers and, by extension, the halberds and swords, their exploitation and intensive use by their resharpening have been stressed (Montero Ruiz et al. 2020), with recycling being the last option when they can no longer be used. This intensive use and the loss of mass caused by sharpening would have resulted in a small remaining amount of potentially recyclable metal that could have been used to make smaller objects (rivets, awls, arrowheads, etc.), as there would not have been enough metal, for example, to make a new dagger. Moreover, the high arsenic (> 3%) content in most of the daggers (Rovira Llorens/Montero Ruiz 2018, 239–241) supports the argument that fresh and not recycled metal was mainly used in their manufacture.

- (4) The lead isotope analyses of Argaric objects published by Stos-Gale et al. (1999) and those from the OXALID database were carried out in the 1990s in the Oxford laboratory using the TIMS technique. The most recent analyses were carried using the plasma sourced multi-collector mass spectrometry (MC-ICP-MS) technique by the Geochronology Services of the University of the Basque Country (SGIker); MC-ICP-MS results are more accurate than TIMS data, especially in the ratios that include the ^{204}Pb isotope. The partial overlapping of some isotopic fields means that these differences in the margins of error can be decisive in proposing the origin of the metal. This also affects many of the mineral results published prior to the generalisation of MC-ICP-MS, as the isotopic fields that can be deduced from them can be displaced or are greater than those proposed with the new data (see for example the situation in the Vera Basin, Murillo-Barroso et al. 2019).
- (5) Argaric metallurgy may have used mineral resources from the different copper mineralisations in its geographical area, but it is also possible that the circulation and trading system included neighbouring areas. The hypothesis of a predominance of copper from the Alto Guadalquivir area (Lull et al. 2010b, 24–26), identified with the settlement of Peñalosa as a supplier of metal on a supra-regional level, cannot be validated with the information compiled in fig. 3. In it metal matching with the area of Linares is observed to be the minority and many other pieces would have come from other mineral resources that remain to be defined. Whereas some of the tin bronzes with arsenic could have been made with ore from Linares (fig. 3), only one of the tin bronzes without arsenic falls within the limits of this isotopic field (a spiral adornment from T746 at El Argar, see case 6 below). As it is an adornment, the likelihood of recycling is greater, which would have entailed a loss of arsenic. Moreover, its corroded condition means that the surface analysis and the evaluation of its arsenic content should be treated with caution.

Interpretation of the Origin of the El Argar Tin Bronze Objects

Tin bronzes without arsenic were examined to assess whether these productions were actually manufactured with resources from outside the Argaric area. The strategy followed was comparing these Argaric tin bronzes without arsenic with all the mineralisations on the Iberian Peninsula (fig. 4). Each case study was numbered (case 1–6) and the distribution of the closest ores identified by Euclidian distance (tables 2–7), following the formula and procedure described by Birch et al. (2019), framed in a rectangle to facilitate the comparative distribution in each graph (fig. 4–6). It was also corroborated that those minerals show a coherent distribution in the rest of the isotopic ratio combinations and checked whether those minerals coincide with a specific geographical area that could act as a reference for establishing a possible provenance.

Comments about two cases of tin bronze with arsenic are also included in this study with the aim of evaluating the production of tin bronzes using local copper resources and the continuity in the use of these mineral resources: case 7 of the dagger from Tomb 21 at El Cerro de la Encina that presents isotopic values very similar to those of another item of copper with arsenic from the same tomb and another two Argaric objects, and case 8 of the awl from Gatas.

Case 1: Small 3R dagger from T62 at El Oficio. This double tomb contained a combination of tin bronze and arsenical copper objects in the two burials, one of them with a halberd. According to the distribution described by Flores, this bronze dagger would have belonged to the woman and was found at her feet (Montero Ruiz et al. 2019). Of the group of minerals surrounding them in fig. 4, only those from Val de Ribes in Andorra and galeña from the Atrevida Mine in Tarragona maintain the position of proximity in the complementary graphs using different combinations of isotopic ratios (table 2).

Case 2: 4R Dagger from T62 at El Oficio. On this occasion the tin bronze dagger is accompanying the burial with the copper halberd. Its isotopic values coincide with a group of minerals in fig. 4

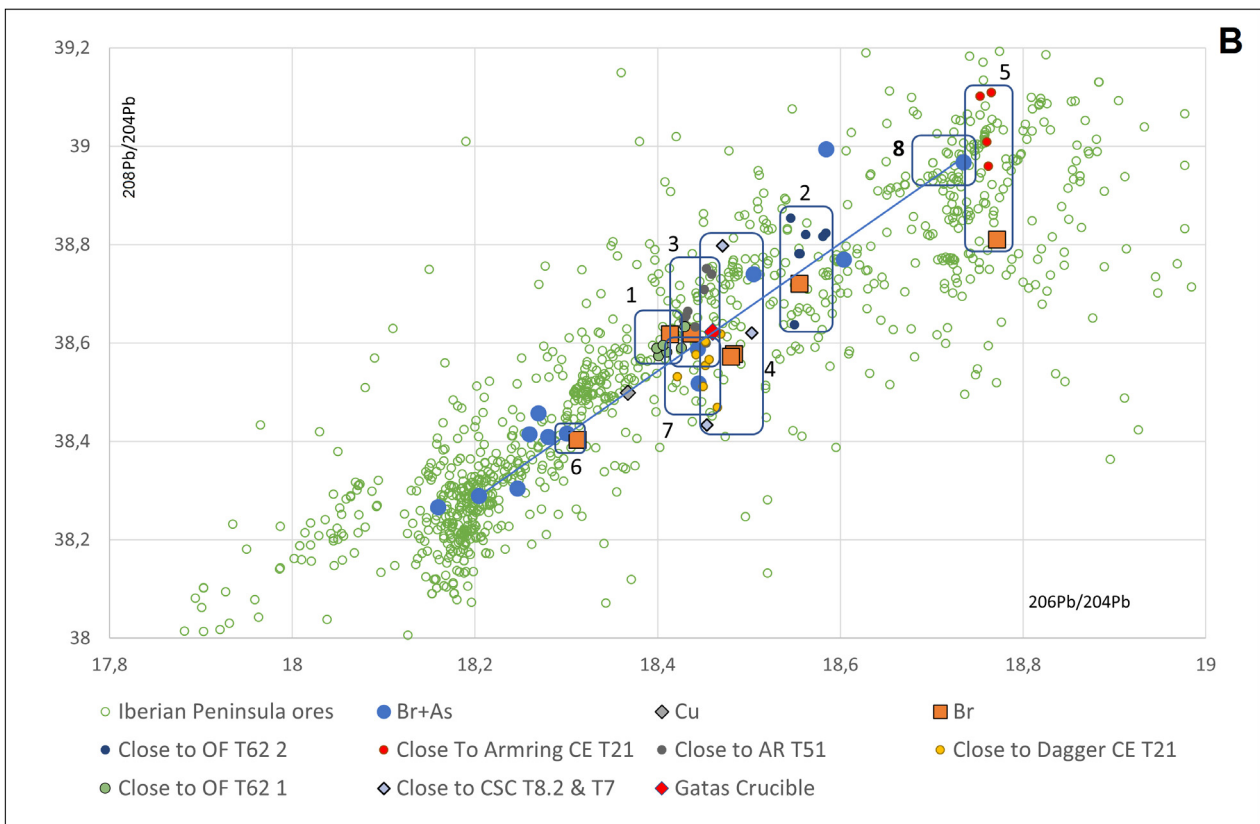
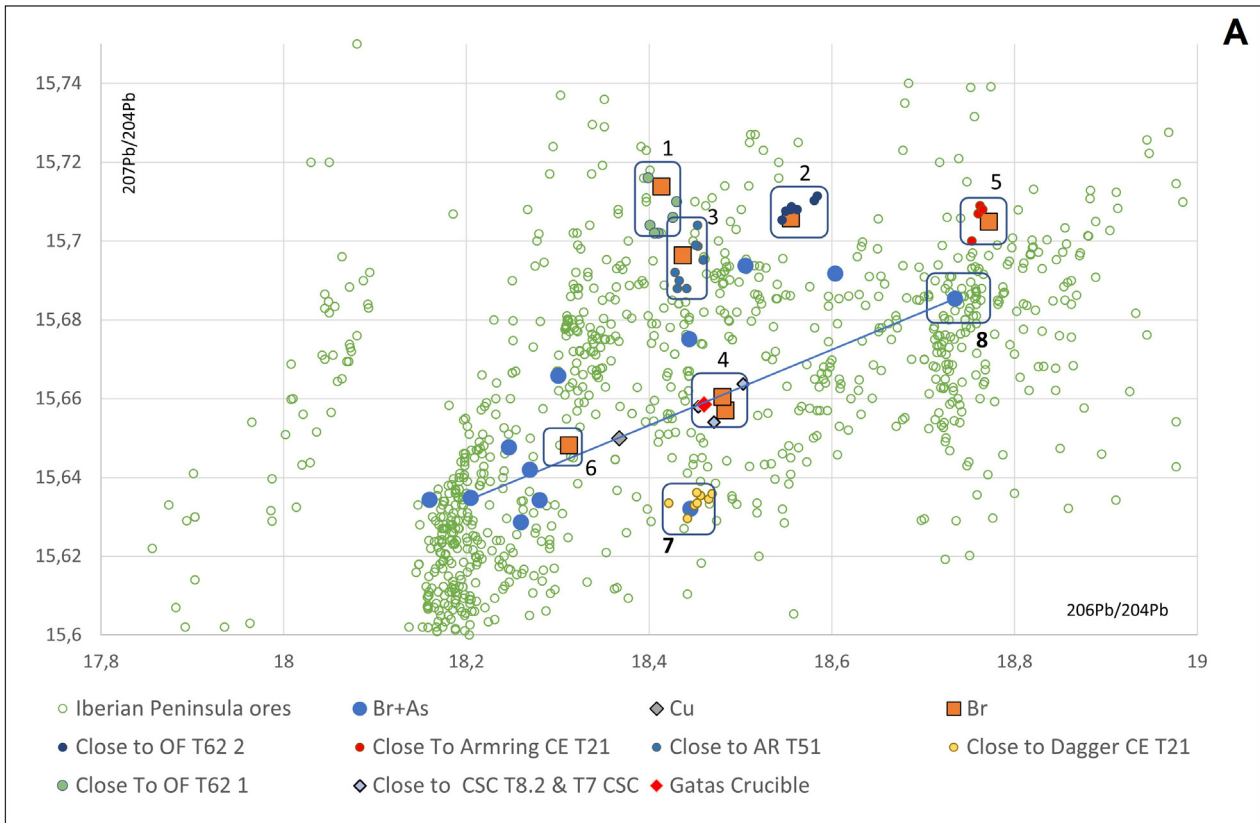


Fig. 4. General distribution of Lead Isotope Analysis (LIA) made of copper and lead ores from the Iberian Peninsula (Montero Ruiz 2018) and El Argar metal objects by type of alloy (Cu = pure copper; Cu+As = copper with arsenic > 0.2%; Br = tin bronze without arsenic; Br+As = tin bronze with As > 0.2%). The numbers refer to the cases described and commented in the text. The closest ore samples to each of these cases inside the rectangles are identified in the tables.

Site	Type	Inventory	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	Reference	Sn %	As %
El Argar T51	Ring frag-ments	BM-171B	2.09467	0.85135	18.4369	15.6963	38.6192	This paper	10.7	ND
El Argar T746	Spiral	BM-144	2.09710	0.85451	18.3124	15.6482	38.4031	This paper	1.94	ND
El Oficio T62	3R Dagger	BM-227	2.09724	0.85338	18.4135	15.7138	38.6175	This paper	1.94	ND
Cerro de San Cristobal	Awl	OSC 11017	2.08710	0.84709	18.4838	15.6570	38.5776	Murillo-Barroso et al. 2015	6.61	0.01
Cerro de San Cristobal	Ring	OSC 11006	2.08718	0.84741	18.4805	15.6604	38.5719	Murillo-Barroso et al. 2015	4.47	0.01
Cerro de la Encina T21	Dagger	MO 39281	2.04937	0.82343	19.0859	15.7161	39.1139	Murillo-Barroso et al. 2015	8.9	0.09
Cerro de la Encina T21	Bracelet	MO 39255 DJ 00745	2.06744	0.83662	18.7718	15.7048	38.8098	Murillo-Barroso et al. 2015	4.09	0.12
El Oficio T62	4R Dagger	BM-225	2.08674	0.84642	18.5554	15.7057	38.7203	This paper	3.39	0.14
Cerro de la Encina T21	Ring	MO 39260 DJ00764	2.0934	0.84805	18.5056	15.6936	38.7392	Murillo-Barroso et al. 2015	8.94	0.23
Fuente Alamo	Awl	FA 74	2.10491	0.85615	18.27	15.6419	38.4567	Stos-Gale et al. 1999	20.7	0.3
Murviedro	Bracelet	MU 57	2.10713	0.86092	18.16	15.6343	38.2655	Stos-Gale et al. 1999	13.2	0.4
Gatas	Awl	G1 Sondeo 3, Conj. 9. Cd 5	2.09918	0.85754	18.247	15.6475	38.3034	Oxalid	12.8	0.4
Cerro de San Cristobal	Bracelet	OSC 7002	2.10112	0.85527	18.28047	15.6342	38.4086	Murillo-Barroso et al. 2015	5.58	0.42
El Argar T429	Sword	BM-154	2.09210	0.84986	18.4443	15.675	38.5873	This paper	7.9	0.5
Gatas	Awl	G26 G89-2B- 14A1-Cd5 (M2)	2.07987	0.83722	18.735	15.6853	38.9664	Stos-Gale et al. 1999	3.0	0.8
Cerro de San Cristobal	Scraper	OSC 11015	2.1032	0.8588	18.20494	15.6347	38.2883	Murillo-Barroso et al. 2015	4.9	0.87

Site	Type	Inventory	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	Reference	Sn %	As %
Cabezo Negro	Fragments	CN72-I-II-29 (MU 48)	2.09809	0.85061	18.585	15.8086	38.993	Stos-Gale et al. 1999	1.2	1.1	
Fuente Alamo	Axe	FA 1432/5 (FA13)	2.0839	0.84346	18.604	15.6917	38.7689	Stos-Gale et al. 1999	1.1	1.2	
Cabezo Negro	Awl	MU 50	2.1037	0.85589	18.26	15.6286	38.4136	Stos-Gale et al. 1999	18.6	1.2	
El Argar	4R Dagger	A-14025 (AM 20)	2.09909	0.856	18.301	15.6657	38.4154	Stos-Gale et al. 1999	5.7	1.4	
Cerro de la Encina T21	Dagger	MO-39264 DJ 00753	2.08821	0.84746	18.4454	15.632	38.5177	Murillo-Barroso et al. 2015	2.36	1.93	

Table 1. Lead Isotope Analyses of tin bronze objects of the El Argar Culture by Stos-Gale et al. 1999 and Oxalid (TIMS), Murillo-Barroso et al. 2015 and this study (MC-ICP-MS). Elemental analysis data by Murillo-Barroso et al. 2015 (ICP-MS), the rest by ED-XRF.

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d	Reference
El Oficio T62-1			BM-227	18.4135	15.7138	38.6175	0.85338	2.09724	0.0000	This paper
Val de Ribes	An	Pyrenees	377-g2	18.401	15.704	38.574	0.8534	2.0963	0.0463	Romer/Soler 1995
Val de Ribes	An	Pyrenees	187-d	18.41	15.702	38.582	0.8529	2.0957	0.0376	Romer/Soler 1995
Val de Ribes	An	Pyrenees	377-sp	18.399	15.716	38.589	0.8542	2.0973	0.0321	Romer/Soler 1995
Val de Ribes	An	Pyrenees	478-a	18.426	15.706	38.59	0.8524	2.0943	0.0312	Romer/Soler 1995
Val de Ribes	An	Pyrenees	377-g	18.406	15.702	38.595	0.8531	2.0969	0.0265	Romer/Soler 1995
Atrevida	TA	Catalonian Coastal Ranges	377-g2	18.43	15.71	38.633	0.8524	2.0962	0.0230	Canals/Cardellach 1997

Table 2. Lead Isotope Analyses of the small 3R Dagger from T62 at El Oficio and its closest ore samples according to their Euclidean distances (d).

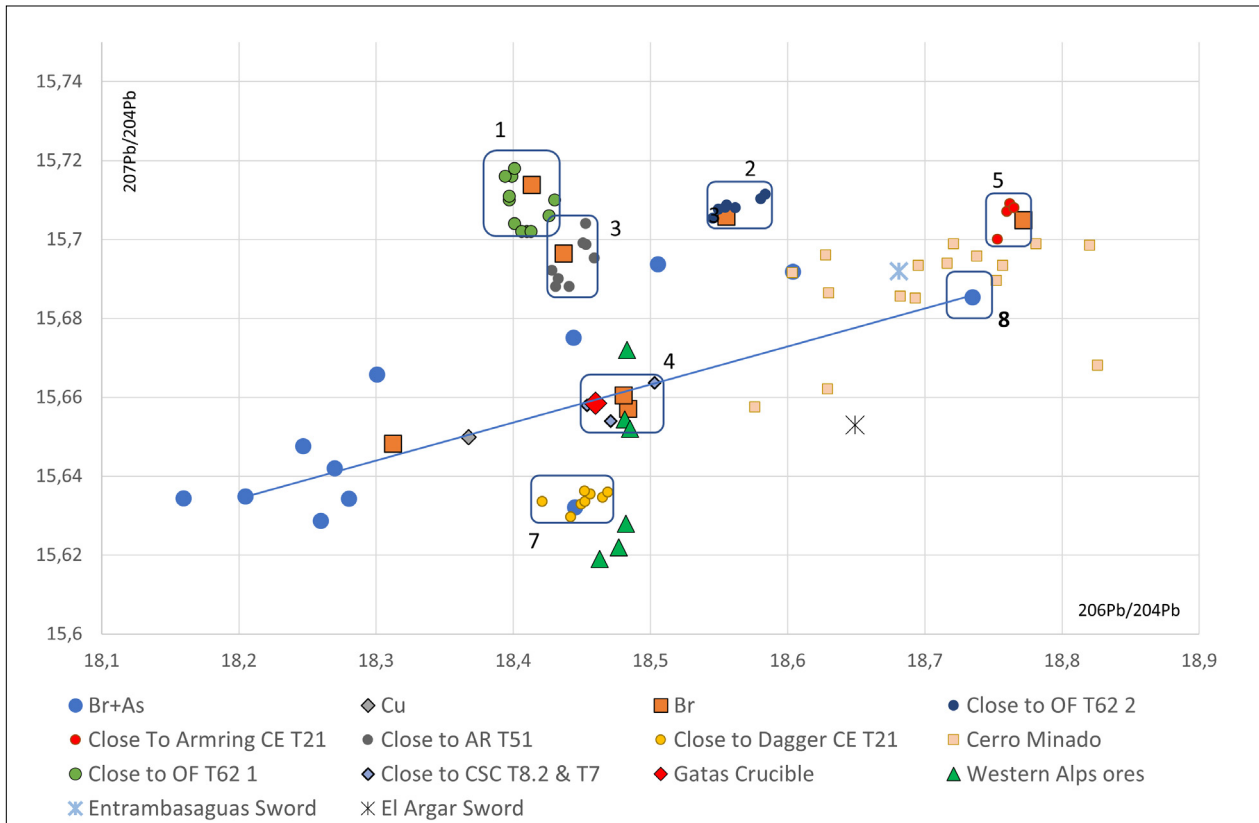


Fig. 5. Lead isotope distribution of the El Argar tin bronze alloys with reference to the number case and the closest ores identified by Euclidian distance (d). The distribution of Cerro Minado (Almería) data and some western Alps copper ores is discussed in the text.

that also maintain their position in the graph in fig. 5 and come from the Pyrenees area (table 3). The minerals from the Les Ferrerres Mine in Girona coincide, but we cannot confirm that origin because the polymetallic mineralisation contains copper arsenates (Alcalde et al. 1998, 95).

Case 3: Earring from T51 at El Argar. This piece stands between two blocks of minerals in fig 4. They are all minerals from the mining zones of Tarragona and Barcelona, which suggests they may have come from the northeastern Iberian Peninsula (table 4), without ruling out areas in the south of France (not represented in the figures).

Case 4: Awl and ring from El Cerro de San Cristobal. The values of these two pieces are very close, despite the fact that they were found in different tombs: 8.2 and 7 respectively. There are very few minerals near them in fig. 4A. Moreover, the three closest minerals come from very different areas: La Sultana Mine in Ossa Morena, Asturiana in the Central Iberian region and the El Robledal, an iron ore mine in Málaga (table 5).

Unlike the previous cases, any specific orientation is missing and it is feasible that they are either from mineralisations that have yet to be characterised or that their origin has to be sought outside the Iberian Peninsula. In the latter case, they are most compatible with mines of the Piedmont area in the western Alps, including some samples from Saint Verán and Valle Strona (fig. 5 and table 5). The interpretation of these pieces is further complicated by the proximity of a crucible from Gatas that contains copper and tin remains, although it is attributed to a post-Argaric chronology. Due to the absence of nearby minerals, the isotopic values could be explained by re-melting or recycling in the crucible of pieces with isotopic signatures from Linares or Faja Piritica and from the southeast (Cerro Minado-Mazarrón); the best mixed alignment (mixing line in fig. 4-6) is found between the scraper from El Cerro de San Cristobal and the awl from Gatas (case 8), both made of bronze with arsenic. In fig. 4B, the crucible appears displaced from the two pieces we are

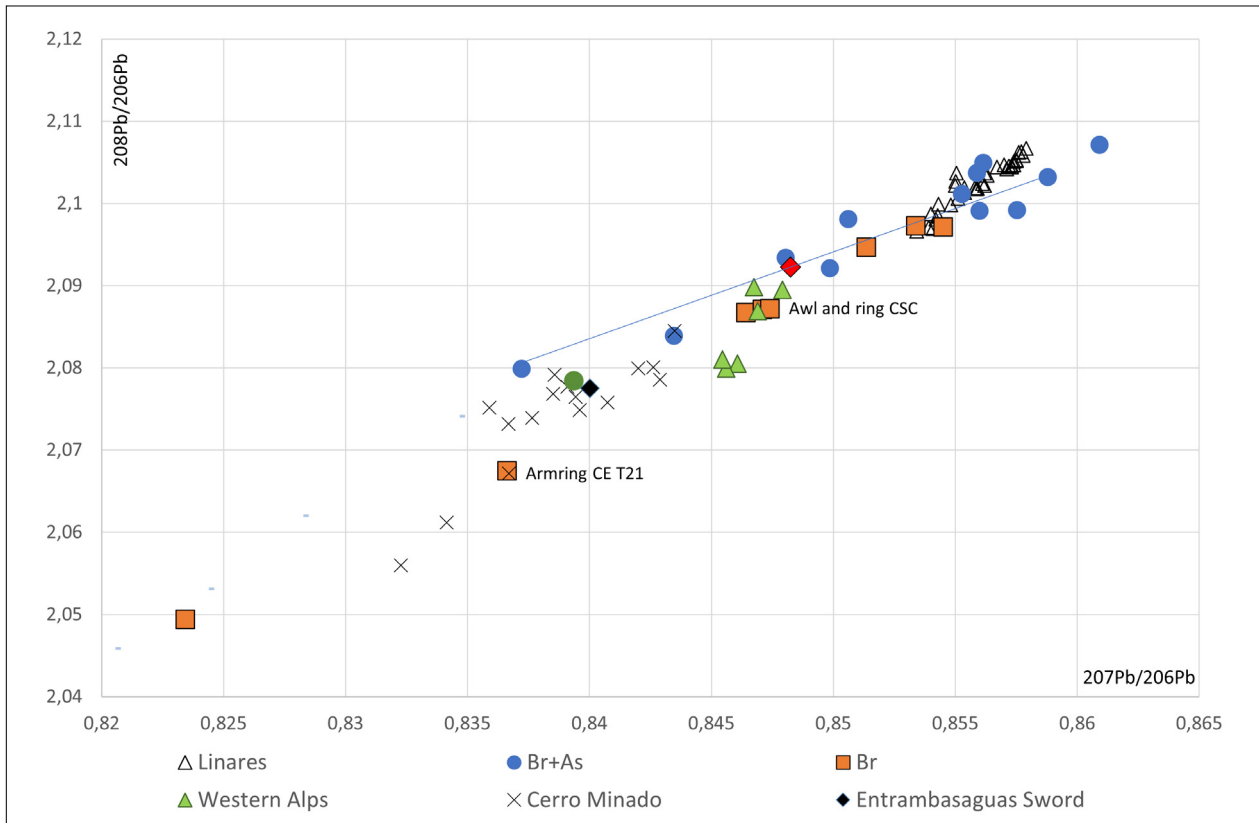


Fig. 6. Lead isotope distribution of the El Argar tin bronze alloys in a different combination than in fig. 4 and 5. The Cerro Minado and western Alps ores are included in relation to some objects discussed in the text.

interpreting, but maintains its alignment with the pieces suggested as mixed. In fig. 6, it can clearly be seen that if the crucible represents recycling with a mixture from those two origins, these two objects are slightly separated from the mixture line and cannot be explained by that specific circumstance; however, it is possible that there are other similar mixtures. The fact that we are dealing with an awl and a ring would explain the probable choice of a mixture, although the Alpine option should also be evaluated in the future with more information on the origins and circulation of metal, unless other zones yet to be characterised can complete that void in the data from the Iberian Peninsula.

Case 5: Bracelet from T21 at El Cerro de la Encina. The group of nearby minerals in fig. 4 all belong to ore from the Cartagena and Mazarrón Mountains (table 6). However, their position in the lower graph (fig. 4B) with the ratio $^{208}\text{Pb}/^{206}\text{Pb}$ is inconsistent with that origin. The minerals with similar ratios from outside the Iberian Peninsula

are found in the zone of Tuscany in Italy, although the values do not coincide with the ratio $^{207}\text{Pb}/^{204}\text{Pb}$ with the bracelet in values of 15.70, which are always lower in Italian minerals. Another feasible option would be the Cu-Fe minerals from the Murcia region defined by Escanilla (2017), as minerals from Murcia and Almería coincide well in those ratios that use the ^{204}Pb isotope, although the data known to date are higher in the $^{208}\text{Pb}/^{204}\text{Pb}$ ratio. In various graphs (fig. 5–6), the minerals from Cerro Minado would explain the link, although Cerro Minado is a mineralisation with arsenic, meaning that it is probably from a site in the southeast that has yet to be characterised, such as those iron and copper ore mines surveyed by Escanilla.

Case 6: Coil from T746 at El Argar. This object made of tin bronze without arsenic is the only bronze that can be associated with Linares, together with Bracelet OSC7002 from El Cerro de San Cristóbal (Murillo-Barroso et al. 2015), which in this case also presents low levels of arsenic (0.42%).

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d	Reference
El Oficio T62-2			BM-225	18.5554	15.7057	38.7203	0.84642	2.08674	2.08674	0.0000	This paper
Mineta del Salvador	TA	Catalonian Coastal Ranges	PA26108	18.5496	15.7076	38.6375	0.84679	2.08293	2.08293	0.0830	CSIC Unpublished
Val de Ribes	An	Pyrenees	RB-13	18.562	15.708	38.821	0.84624	2.09142	2.09142	0.1009	Romer/Soler 1995
Les Ferreres	GI	Pyrenees	ROC-1	18.5547	15.7080	38.7820	0.84658	2.09014	2.09014	0.0617	CSIC Unpublished
Les Ferreres	GI	Pyrenees	ROC-3	18.5558	15.7087	38.782	0.84656	2.09001	2.09001	0.0618	CSIC Unpublished
Les Ferreres	GI	Pyrenees	PA21879	18.5807	15.7103	38.8173	0.84552	2.08912	2.08912	0.1004	CSIC Unpublished
Les Ferreres	GI	Pyrenees	PA21878	18.5839	15.7114	38.8241	0.84543	2.08913	2.08913	0.1078	CSIC Unpublished

Table 3. Lead Isotope Analyses of the 4R Dagger from T62 at El Oficio and its closest ore samples according to their Euclidean distances (d).

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d	Reference
El Argar T51			BM171B	18.4369	15.6963	38.6192	0.85135	2.09467	2.09467	0.0000	This paper
Linda Mariquita	TA	Catalonian Coastal Ranges	PA12007A	18.431	15.688	38.655	0.8512	2.0973	2.0973	0.0372	Montero Ruiz et al. 2009
Atrevida	TA	Catalonian Coastal Ranges		18.441	15.688	38.633	0.8507	2.095	2.095	0.0166	Canals/Cardellach 1997
Linda Mariquita	TA	Catalonian Coastal Ranges	PA12007B	18.433	15.690	38.665	0.8512	2.0976	2.0976	0.0464	Montero Ruiz et al. 2009
Solana del Bepo	TA	Catalonian Coastal Ranges	PA25210	18.4283	15.6921	38.6459	0.8515	2.0971	2.0971	0.0284	Montero Ruiz 2018
Can Franquesa	B	Catalonian Coastal Ranges	PA12757	18.4592	15.6952	38.7398	0.8502	2.0986	2.0986	0.1226	CSIC Unpublished
Torrent des Bruix	B	Catalonian Coastal Ranges	PA13227	18.4532	15.6987	38.7512	0.8507	2.0999	2.0999	0.1330	CSIC Unpublished

Table 4. Lead Isotope Analyses of the ring from T51 at El Argar and its closest ore samples according to their Euclidean distances (d).

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d (awl)	d (ring)	Reference
Awl CSC T8.2			OSC 11017	18.4838	15.6570	38.5776	0.84709	2.0871	0.0000	0.0000		Murillo-Barroso et al. 2015
Ring CSC T7			OSC 11006	18.4805	15.6604	38.5719	0.84741	2.08718	0.0070	0.0000		Murillo-Barroso et al. 2015
Robledal	MA	Betics		18.4537	15.6580	38.4336	0.8485	2.0827	0.1466	0.1409		Renzi et al. 2016
Asturiana		CIZ	AS-1042	18.471	15.654	38.798	0.8476	2.1005	0.2213	0.2264		Tornos/Chiaradia 2004
Mina la Sultana	H	Ossa Morena	LS8	18.503	15.664	38.621	0.8465	2.0873	0.0484	0.0541		Hunt Ortiz 2003
Saint Veran	FR	Queyras	SVE_Ap3 bis	18.4812	15.6544	38.5678	0.8469	2.0869	0.0100	0.0073		CSIC Unpublished
Valle di Susa	IT	Piemonte	M/U 9748	18.483	15.672	38.621	0.84791	2.0895	0.0464	0.0505		Artoli et al. 2009
Val Strona	IT	Piemonte	28b	18.485	15.652	38.63	0.84674	2.08980	0.0531	0.0589		Cumming et al. 1987

Table 5. Lead Isotope Analyses of the awl and the ring from tombs 8.2 and 7 at El Cerro de San Cristóbal and their closest ore samples from Iberia and the Alps according to their Euclidean distances (d).

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d	Reference
Armring T21 CE			MO 39255	18.7718	15.7048	38.8098	0.83662	2.06744	0.0000		Murillo-Barroso et al. 2015
Rajado	MU	Betic		18.762	15.709	38.96	0.8373	2.0765	0.1506		Graeser/Friedrich 1970
Confianza	MU	Betic		18.76	15.707	39.009	0.8373	2.0794	0.1996		Graeser/Friedrich 1970
Mazarron	MU	Betic		18.765	15.708	39.110	0.8371	2.0842	0.3003		Oxalid
San Cristobal	MU	Betic		18.765	15.708	39.11	0.8371	2.0842	0.3003		Arribas/Tosdal 1994
Barranco de Gos	MU	Betic		18.753	15.700	39.102	0.8372	2.0851	0.2928		Montero-Ruiz/Mu- rillo-Barroso 2010
Cerro Minado	AL	Betic		18.752	15.690	38.763	0.8367	2.0672	0.0529		Oxalid

Table 6. Lead Isotope Analyses of the bracelet from tomb 21 at El Cerro de la Encina and its closest ore samples from Iberia according to their Euclidean distances (d).

Sample	Prov.	Region	Id.	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{208}\text{Pb}/^{206}\text{Pb}$	d (D)	d (a)	d (H)	Reference
(D) Dagger T21 CE			MO39264	18.4454	15.632	38.5177	0.8475	2.0882	0.000			Murillo-Barroso et al. 2015
(a) Armring T21 CE			MO39261	18.4456	15.6330	38.4901	0.8475	2.0867	0.028	0.000		Murillo-Barroso et al. 2015
(H) Halberd PDF				18.4388	15.6394	38.4967	0.8482	2.0878	0.023	0.011	0.000	Alvarez Penanes 2016
Membrillejos	CO	Los Pedroches	GAL-33	18.442	15.6296	38.577	0.8475	2.0918	0.059	0.087	0.081	Santos Zalduogui et al. 2004
Fontanar	CO	Los Pedroches	CO17	18.4497	15.6329	38.5119	0.8473	2.0874	0.007	0.022	0.017	Klein et al. 2009
C° Minillas	CO	Los Pedroches	CO61	18.4212	15.6335	38.5315	0.8487	2.0917	0.028	0.048	0.043	Klein et al. 2009
Quiros	CO	Los Pedroches	CO95	18.4523	15.6335	38.5548	0.8472	2.0894	0.038	0.065	0.059	Klein et al. 2009
La Pilla	CO	Los Pedroches	CO48	18.4652	15.6346	38.4697	0.8467	2.0834	0.052	0.028	0.034	Klein et al. 2009
Taberno	CO	Los Pedroches	CO92	18.4562	15.6354	38.5669	0.8472	2.0896	0.050	0.078	0.071	Klein et al. 2009
San Rafael	CO	Los Pedroches	GAL-31	18.469	15.6359	38.6187	0.8466	2.091	0.104	0.131	0.124	Santos Zalduogui et al. 2004
El Águila	CO	Los Pedroches	GAL-34	18.452	15.6362	38.6034	0.8474	2.0921	0.086	0.113	0.107	Santos Zalduogui et al. 2004

Table 7. Lead Isotope Analyses of the Argaric objects matching Los Pedroches isotopic field according to their Euclidean distances (d).

Site	Type	Inventory	$^{208}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{206}\text{Pb}/^{204}\text{Pb}$	$^{207}\text{Pb}/^{204}\text{Pb}$	$^{208}\text{Pb}/^{204}\text{Pb}$	Reference	Sn %	As %
Entrambasaguas	Sword	12116	2.0775	0.84002	18.681	15.692	38.810	This paper	8.94	0.23
El Argar	Sword	AL-14014 (AM18)	2.0784	0.8394	18.649	15.653	38.761	Stos-Gale et al. 1999	< 0.2	2.8

Table 8. Lead Isotope Analysis of two Argaric type Swords: El Argar by Stos-Gale et al. 1999 (TIMS and Ed-XRF) and Entrambasaguas by this paper (MC-ICP-MS and SEM [Arias et al. 2005]).

Case 7: Dagger from T21 at El Cerro de la Encina. This piece is a tin bronze with arsenic and is of interest in this study as the lead isotopes are similar to another piece made of arsenical copper from the same grave (a bracelet) and two more objects (the halberd from Puebla de Don Fadrique and the dagger from El Cerro de San Cristobal), also of arsenical copper. This coincidence between tin bronzes and arsenical copper objects was not detected in previous case studies, except in the finds that may have come from the Linares area. The minerals that fully coincide with this group of objects are all from the Los Pedroches area, with several samples from the Cardeña-El Zumajo Mines (*table 7*). This zone is well known for the exploitation of lead and copper since Roman times (Klein et al. 2009).

Case 8: The awl from Gatas is a tin bronze with arsenic. Since it was first studied, this piece has been linked to ore from Mazarrón (Stos-Gale et al. 1999), a link that remains feasible, although we now have better knowledge of the isotopic field of Cerro Minado (Murillo-Barroso et al. 2019), with which it partially overlaps. Whether it is from Mazarrón or another mineralisation from the southeast, it serves to confirm that tin bronzes could be manufactured using local copper ores mined in this geographical area.

General Evaluations

The data presented offers a first approach to evaluate the access to tin bronze in the Argaric area, although the panorama must be completed with the tin bronzes with arsenic, which remain to be interpreted. The two daggers from T62 at El Oficio have the oldest dates (Montero Ruiz et al. 2019), and the only probable provenance at this moment are minerals from the northeastern Iberian Peninsula, probably the Pyrenees area. The earring from T51 at El Argar could also suggest a northeastern origin, although this type of object is less reliable for deciding whether it was of mixed composition or recycled. The metal recycling option is plausible for the awl and ring from El Cerro de San Cristóbal, although the Piedmont mines in the western Alps cannot be ruled out as a possible source. One of the bracelets from T21 at

El Cerro de la Encina may be tin bronze manufactured with coastal mineralisations from Almería and Murcia. Although we have no exact coincidences in this case, it is probable that looking could correspond to copper without arsenic from the Águilas-Mazarrón-Cartagena mines, for which isotopic data is not available. This option would imply that those resources that were used in a minority of cases in the Chalcolithic (for example, at the archaeological site of La Ciñuela, Mazarrón) may have continued to be accessible during the Bronze Age, contrary to the suggestion of Escanilla (2016). Unlike the previous cases, in which the foreign origin made it possible that the object was imported, the use of copper from Murcia suggests that the alloying would have been carried out locally, an argument that is supported by the tin bronze with arsenic of the Gatas awl linked to the mines of Mazarrón. In the absence of a more detailed study of the data regarding tin bronzes with arsenic, this Argaric tin bronze based on local copper resources is currently in the minority, as only two other objects can be linked fairly reliably to the Linares mines. In contrast, it is possible that the dagger made of tin bronze with arsenic from T21 at El Cerro de la Encina, with isotopic values similar to a copper bracelet from the same tomb, came from the mines of Los Pedroches (Córdoba); these mines are located outside the Argaric area and both objects could therefore be considered as imported. This same provenance can be attributed to the halberd from Puebla de Don Fadrique and a dagger from El Cerro de San Cristóbal, both archaeological sites in the province of Granada. If it is also noted that the date of the halberd is prior to 1800 calBC and that Argaric settlement of El Cerro de San Cristóbal only developed in the final phases of the culture, the external supply between the zone of Los Pedroches in Córdoba province and the archaeological sites in Granada would have been maintained for certain duration or regularity.

The identification of tin bronzes with a likely provenance from areas outside El Argar (Pedroches, Pyrennes or the Alps) and the identification of some unusual objects (decorated daggers) suggest that an exchange of manufactured metal objects underlies in this demand. Not a single tin bronze ingot has been identified in the

Early and Middle European Bronze Age and the movement of copper ores or copper ingots from very far distances, although plausible, has not any archaeological evidence supporting it in any of the intermediate areas. This object trade must be understood as exchange of prestige items and not as supply of raw material. The elements exchanged could be of the same nature based on a common symbolic value, as technical skills (tin bronze production) and raw material are identified at the end-destination (Argaric Area) as well.

To verify this option, metal of Argaric origin would have to be identified in areas outside El Argar. The case of Linares is clear, not only for its high level of production, but also for its position on the communication route between the southern Meseta and the Guadalquivir valley. Copper from Linares has been identified in the present-day province of Madrid during the Protocogotas and Cogotas cultures (Galindo San José et al. 2018), as well as at the archaeological site of Castillejo de Bonete (Terrinches, Ciudad Real) (Montero Ruiz et al. 2014).

More illustrative is the case of the sword from Entrambasaguas or Ruchano Cave (Santander), which is included in the Argaric typology (Almagro Gorbea 1976; Moreno Onorato/Contreras Cortés 2015). The sword is made of tin bronze, although, due to the analytical technique used (Scanning Electron Microscopy), we cannot be sure whether it contains any arsenic. The isotopic signature (*fig. 6* and *table 8*) coincides quite well with the short sword (No. 14014 in the museum of Almería) attributed to the El Argar site (*table 8*). Although one is made of arsenical copper and the other one of tin bronze, according to what has been discussed in the previous pages, they would both have originated from the coastal mineralisations of Murcia/Almería. This sword constitutes a new example of tin bronze production from local ores, at the same time as the find of this sword in the north of the Iberian Peninsula supports the concept of the exchange of metal objects as a prestige good. Metal objects would have been distributed to different

places far from where they were produced. At the same time, those producing sites consumed or used, at least partially, metals manufactured by other external producers (Montero Ruiz/Murillo-Barroso 2010, 48).

The supply of tin for alloying with the local copper resources may have limited the capacity for the development or the application of this technology, as features such as the predominance of poor bronzes and their use mainly in adornments shows that only small amounts of tin were available (Montero Ruiz et al. 2019). For the time being, attention is drawn to the fact that the local production of tin bronzes, with or without arsenic, is linked to the only two zones in which local tin ores are mentioned (the coasts of Murcia and Linares).

As with many other aspects of Argaric metallurgical production, we still lack evidence in the archaeological record that would reduce the level of uncertainty regarding the interpretation of the indirect data. The approach followed in this paper needs more data with reliable elemental analysis to confirm the interpretation of these preliminary results.

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Bibliography

- Alcalde et al. 1998*: G. Alcalde/M. Molist/I. Montero Ruiz/L. Planagumà/M. Saña/A. Toledo, Producciones metalúrgicas en el nordeste de la Península Ibérica durante el III milenio cal. AC. El taller de la Bau-ma del Serrat del Pont (Tortellà, Girona). *Trabajos de Prehistoria* 55.1, 1998, 81–100.
- Almagro Gorbea 1976*: M. Almagro Gorbea, La espada de Entrambasaguas. Aportación a la secuencia de las espadas del Bronce en el Norte de la Península Ibérica. 40. Aniversario del Centro de Estudios Montañeses 3 (Santander 1976) 453–477.
- Alvárez Penanes 2016*: P. Alvárez Penanes, Medida de Relaciones isotópicas de plomo en muestras arqueológicas mediante MC-ICP-MS (Master Thesis Universidad de Oviedo 2016), <<https://digibuo.uniovi.es/dspace/handle/10651/39068>> (last access 04.10.2021).
- Aranda et al. 2015*: G. Aranda/S. Montón/M. Sánchez Romero, The Archaeology of Bronze Age Iberia. Argaric Societies (Oxford 2015).
- Arias et al. 2005*: P. Arias/R. Ontañón/J. A. Polanco/J. Setién/S. Rovira/I. Montero, Aproximación a la tecnología metalúrgica durante el Calcolítico y Edad del Bronce de Cantabria. In: M. R. González Morales/J. Solózarro (eds.), II Encuentro de Historia de Cantabria 1 (Santander 2005) 53–72.
- Arribas/Tosdalet et al. 1994*: A. Arribas/R. M. Tosdal, Isotopic Composition of Pb and S in Base and Precious Metal Deposits of the Betic Cordillera, Spain. Origin and Relationship to other European Deposits. *Economic Geology* 89, 1994, 1074–1093.
- Artioli et al. 2009*: G. Artioli/I. Angelini/I. Giunti/P. Omenetto/I. Villa, La provenienza del metallo degli oggetti di Monte Cavanero. Considerazioni basate sugli isotopi del Pb e sulla geochimica delle mineralizzazioni cuprifere limitrofe. In: M. Venturino Gambari (ed.), Il ripostiglio del Monte Cavanero di Chiusa di Pesio (Cuneo) (Alessandria 2009) 167–178.
- Birch et al. 2019*: T. Birch/K. J. Westner/F. Kemmers/S. Klein/H. E. Höfer/H.-M. Seitz, Retracing Magna Graecia's Silver. Coupling Lead Isotopes with a Multi-Standard Trace Element Procedure. *Archaeometry* 62.1, 2019, 81–108.
- Brandherm 2003*: D. Brandherm, Die Dolche und Stabdolche der Steinkupfer- und älteren Bronzezeit auf der Iberischen Halbinsel (Stuttgart 2003).
- Calderón 1910*: S. Calderon, Los Minerales de España (Madrid 1910).
- Canals/Cardellach 1997*: A. Canals/E. Cardellach, Ore Lead and Sulphur Isotope Pattern Isotope from the Low Temperatures Veins of the Catalanian Coastal Ranges (NE Spain). *Mineralium Deposita* 32, 1997, 243–249.
- Cassard et al. 2012*: D. Cassard/G. Bertrand/F. Maldan/G. Gaàl/K. Juha/S. Aatos/J. M. Angel/N. Arvanitidis/D. Ballas/M. Billa/C. Christidis/D. Dimitrova/P. Eilu/A. Filipe/E. Grazea/C. Inverno/E. Kauniskangas/T. Maki/J. Matos/M. Meliani/C. Michael/V. Mladenova/J. Navas/M. Niedbal/G. Perantonis/J. Pyra/H. Santana/T. Serafimovski/J. J. Serrano/J. Strengel/G. Tasev/F. Tornos/G. Tudor, ProMine Pan-European Mineral Deposit Database. A New Dataset for Assessing Primary Mineral Resources in Europe. Mineral Resources Potential Maps. A Tool for Discovering Future Deposits. 12th–14th March 2012. (Nancy 2012).
- Cumming et al. 1987*: G. L. Cumming/V. Köppel/A. Ferrario, A Lead Isotope Study of the Northeastern Ivrea Zone and the Adjoining Cenerizone (N-Italy). Evidence for a Contaminated Subcontinental Mantle. *Contributions to Mineralogy and Petrology* 97, 1987, 19–30.

- Earle et al. 2015*: T. Earle/J. Ling/C. Uhnér/Z. Stos-Gale, The Political Economy and Metal Trade in Bronze Age Europe. Understanding Regional Variability in Terms of Comparative Advantages and Articulations. *European Journal of Archaeology* 18.4, 2015, 633–657.
- Escanilla 2016*: N. Escanilla, Recursos minerales de cobre y su explotación prehistórica en el sudeste peninsular. El valle del Guadalentín (PhD-Thesis Universitat Autònoma de Barcelona 2016).
- Escanilla 2017*: N. Escanilla, Minería y metalurgia calcolíticas en el sudeste de la península ibérica. Hacia un modelo interconectado. *MARQ. Arqueología y Museos* 8, 2017, 77–100.
- Fernández-Miranda et al. 1995*: M. Fernández-Miranda/I. Montero Ruiz/S. Rovira, Los primeros objetos de bronce en el occidente de Europa. *Trabajos de Prehistoria* 52.1, 1995, 57–69.
- Galindo San José et al. 2018*: L. Galindo San José/V. Marcos Sánchez/I. Montero Ruiz, Metalurgia en el yacimiento de “La Serna”, en Arganda del Rey. In: *Ilustre Colegio Oficial de Doctores y Licenciados en Filosofía y Letras y en Ciencias de la Comunidad de Madrid* (ed.), *Actas de las Jornadas de arqueología madrileña 2016* (Madrid 2018) 149–159.
- Giunti 2011*: I. Giunti, Geochemical and Isotopic Tracers in Copper Deposits and Ancient Artifacts. A Database for Provenance (PhD-Thesis Università degli Studi di Padova 2011).
- Graeser/Friedrich 1970*: S. Graeser/G. Friedrich, Zur Fragestellung und Genese der Blei-Zink Vorkommen der Sierra de Cartagena in Spanien. *Mineralium Deposita* 5.4, 1970, 365–374.
- Hook et al. 1991*: D. R. Hook/I. Freestone/N. D. Meeks/P. T. Craddock/A. Moreno, Early Production of Copper Alloys in Southeast Spain. In: E. Pernicka/G. A. Wagner (eds.), *Archaeometry'90* (Basel 1991) 65–76.
- Hunt Ortiz 2003*: M. A. Hunt Ortiz, Prehistoric Mining and Metallurgy in South West Iberian Peninsula. *British Archaeological Reports. International Series* 1188 (Oxford 2003).
- Hunt Ortiz et al. 2011*: M. A. Hunt Ortiz/F. Contreras Cortés/L. Arboledas, La procedencia de los recursos minerales metálicos en el poblado de la edad de bronce de Peñalosa (Baños de la Encina, Jaén). In: J. M. Mata Perelló/L. Torró i Abat/M. N. Fuentes Prieto/A. Neira Campo/O. Puche Riart (eds.), *Actas del quinto congreso internacional sobre minería y metalurgia históricas en el suroeste europeo* (León – 2008). Libro en homenaje a Claude Domergue (Madrid 2011) 195–206.
- Junghans et al. 1960*: S. Junghans/E. Sangmeister/M. Schröder, Metallanalysen kupferzeitlicher und frühbronzezeitlicher Bodenfunde aus Europa. *Studien zu den Anfängen der Metallurgie* 1 (Berlin 1960).
- Junghans et al. 1968*: S. Junghans/E. Sangmeister/M. Schröder, Kupfer und Bronze in der frühen Metallzeit Europas. *Studien zu den Anfängen der Metallurgie* 2 (Berlin 1968).
- Klein et al. 2009*: S. Klein/C. Domergue/Y. Lahaye/G. P. Brey/H.-M. Von Kaenel, The Lead and Copper Isotopic Composition of Copper Ores from the Sierra Morena (Spain). *Journal of Iberian Geology* 35, 2009, 59–68.
- Ling et al. 2019*: J. Ling/E. Hjärthner-Holdar/L. Grandin/Z. Stos-Gale/K. Kristiansen/A. L. Melheim/G. Artioli/I. Angelini/R. Krause/C. Canovaro, Moving Metals IV. Swords, Metal Sources and Trade Networks in Bronze Age Europe. *Journal of Archaeological Science. Reports* 26, 2019, 101837.
- Lull 1983*: V. Lull, La cultura del Argar. Un modelo para el estudio de las formaciones económico-sociales prehistóricas (Madrid 1983).
- Lull et al. 2010a*: V. Lull/R. Micó/C. Rihuete/R. Risch, Metal y relaciones sociales de producción durante el III y II milenio ANE en el sudeste de la Península Ibérica. *Trabajos de Prehistoria* 67, 2010, 323–347.
- Lull et al. 2010b*: V. Lull/R. Micó/C. Rihuete/R. Risch, Las relaciones políticas y económicas de El Argar. Menga. *Revista de Prehistoria de Andalucía* 1, 2010, 11–35.
- Lull et al. 2017*: V. Lull/R. Micó/C. Rihuete/R. Risch/N. Escanilla, Halberdiers and Systems of Combat in the Argaric. *Oxford Journal of Archaeology* 36.4, 2017, 375–394.

- Mongiatti/Montero Ruiz 2020*: A. Mongiatti/I. Montero Ruiz, Rediscovering Famous Assemblages. A Rare Bronze Age Crucible from El Argar, Spain. *Archaeometry* 62.2, 2020, 329–345.
- Montero Ruiz 1994*: I. Montero Ruiz, El origen de la metalurgia en el sudeste de la Península Ibérica (Almería 1994).
- Montero Ruiz 1999*: I. Montero Ruiz, Sureste. In: G. Delibes/I. Montero Ruiz (eds.), *Las primeras etapas metalúrgicas en la Península Ibérica, II. Estudios regionales* (Madrid 1999) 333–357.
- Montero Ruiz 2018*: I. Montero Ruiz, The Archaeometallurgical Perspective. In: N. Rafel Fontanals/M. A. Hunt Ortiz/I. Soriano/S. Delgado-Raack (eds.), *Prehistoric Copper Mining in the Northeast of the Iberian Peninsula. La Turquesa or Mas de les Moreres Mine* (Cornudella de Montsant, Tarragona, Spain). *Revista d'Arqueologia de Ponent. Extra* 3, 2018, 63–72.
- Montero Ruiz/Murillo-Barroso 2010*: I. Montero Ruiz/M. Murillo-Barroso, La producción metalúrgica en las sociedades argáricas y sus implicaciones sociales. Una propuesta de investigación. Menga. *Revista de Prehistoria de Andalucía* 1, 2010, 37–51.
- Montero Ruiz et al. 2009*: I. Montero Ruiz/M. Gener/M. Renzi/M. A. Hunt Ortiz/S. Rovira/J. F. Santos-Zalduegui, Provenance of Lead in First Iron Age Sites in Southern Catalonia (Spain). In: J. F. Moreau/R. Auger/J. Chabot/A. Herzog (eds.), *Proceedings ISA 2006. 36th International Symposium on Archaeometry* (2–6 May, 2006, Quebec City, Canada) (Quebec 2009) 391–398.
- Montero Ruiz et al. 2014*: I. Montero Ruiz/L. E. Benítez de Lugo/H. J. Álvarez García/C. P. Gutiérrez Neira/M. Murillo Barroso/N. Palomares Zumajo/G. Menchén Herreros/J. Moraleda Sierra/D. C. Salazar García, Cobre para los muertos. Estudio arqueométrico del material metálico procedente del monumento Megalítico prehistórico de Castillejo del Bonete (Terrinches, Ciudad Real). *Zephyrus* 73.1, 2014, 109–132.
- Montero Ruiz et al. 2019*: I. Montero Ruiz/M. Murillo Barroso/D. Hook, La producción de bronce durante El Argar. Frecuencia y criterios de uso. *Boletín del Museo Arqueológico. Nacional* 38, 2019, 9–26.
- Montero Ruiz et al. 2020*: I. Montero Ruiz/M. Murillo Barroso/S. Rovira Llorens, Reciclado o reutilización en la producción metalúrgica argárica. In: P. Díaz-del-Río/K. Lillios/I. Sastre (eds.), *The Power of Reason, the Matter of Prehistory. Papers in Honour of Antonio Gilman Guillén*. *Bibliotheca Praehistorica Hispana* 36 (Madrid 2020) 233–246.
- Moreno Onorato/Contreras Cortés 2015*: A. Moreno Onorato/F. Contreras Cortés, Un arma no solo de prestigio. La espada argárica de Peñalosa (B años de la Encina, Jaén). *Trabajos de Prehistoria* 72.2, 2015, 238–258.
- Murillo-Barroso et al. 2015*: M. Murillo-Barroso/I. Montero Ruiz/G. Aranda Jiménez, An Insight into the Organisation of Metal Production in the Argaric Society. *Journal of Archaeological Science. Reports* 2, 2015, 141–155.
- Murillo-Barroso et al. 2019*: M. Murillo-Barroso/I. Montero Ruiz/J. M. Nieto/M. D. Camalich Massieu/D. Martín Socas/M. Martín Torres, Trace Elements and Lead Isotopic Composition of Copper Deposits from the Eastern Part of the Internal Zone of the Betic Cordillera (SE Iberia). Application to Provenance of Archaeological Materials. *Journal of Iberian Geology* 45.4, 2019, 585–608.
- Murillo-Barroso et al. 2020*: M. Murillo-Barroso/I. Montero Ruiz/M. D. Camalich-Massieu/D. Martín-Socas/M. Labaune/F. Cattin/J. M. Nieto/M. Martín Torres, Raw Material Procurement and Selection in Southeast Iberia's Early Metallurgy. *Trabajos de Prehistoria* 77.1, 2020, 87–112.
- Pare 2000*: C. F. E. Pare, Bronze and the Bronze Age. In: C. Pare (ed.), *Metals Make the World Go Round. Supply and Circulation of Metals in Bronze Age Europe* (Oxford 2000) 1–38.
- Pernicka 2014*: E. Pernicka, Provenance Determination of Archaeological Metal Objects. In: B. W. Roberts/C. Thornton (eds.), *Archaeometallurgy in Global Perspective. Methods and Syntheses* (New York 2014) 239–268.

- Radivojević et al. 2013*: M. Radivojević/T. Rehren/J. Kuzmanović-Cvetković/M. Jovanović/J. P. Northover, Tainted Ores and the Rise of Tin Bronzes in Eurasia, c. 6500 Years Ago. *Antiquity* 87, 2013, 1030–1045.
- Renzi et al. 2016*: M. Renzi/M. Y. Bode/D. Marzoli, Ausbeutung von Bergbauressourcen im Umland von Los Castillejos de Alcorrín (Manilva, Málaga) (Ende 9. und 8. Jh. v. Chr.). *Madrider Mitteilungen* 57, 2019, 139–211.
- Romer/Soler et al. 1995*: R. L. Romer/A. Soler, U–Pb Age and Lead Isotopic Characterization of Au-Bearing Skarn Related to the Andorra Granite (Central Pyrenees, Spain). *Mineralium Deposita* 30, 1995, 374–383.
- Rovira Llorens 2007*: S. Rovira Llorens, La producción de bronce en la Prehistoria. In: J. Molera/J. Farjas/P. Roura/T. Pradell (eds.), *Avances en Arqueometría 2005*. Actas del VI Congreso Ibérico de Arqueometría (Girona 16–19 de noviembre 2005) (Girona 2007) 21–35.
- Rovira Llorens/Montero Ruiz 2003*: S. Rovira Llorens/I. Montero Ruiz, Natural Tin-Bronze Alloy in Iberian Peninsula Metallurgy. Potentiality and Reality. In: A. Giunlia-Mair/F. Lo Schiavo (eds.), *The Problem of Early Tin*. Proceedings of the XIVth UISPP Congress Liege, 2–8 September 2001. Section 11, Bronze Age in Europe and the Mediterranean. *British Archaeological Reports. International Series 1199* (Oxford 2003) 15–22.
- Rovira Llorens/Montero Ruiz 2018*: S. Rovira Llorens/I. Montero Ruiz, Proyecto de arqueometalurgia de la Península Ibérica (1982–2017). *Trabajos de Prehistoria* 75.2, 2018, 223–247.
- Rovira Llorens et al. 1997*: S. Rovira Llorens/I. Montero Ruiz/S. Consuegra, La primeras etapas metalúrgicas en la Península Ibérica 1. Análisis de materiales (Madrid 1997).
- Santos Zaldegui et al. 2004*: J. F. Santos Zalduegui/S. García De Madinabeitia/J. I. Gil Ibarguchi/F. Palero, A Lead Isotope Database. The Los Pedroches-Alcudia Area (Spain). Implications for Archaeometallurgical Connections across South-Western and South-Eastern Iberia. *Archaeometry* 46, 2004, 625–634.
- Siret/Siret 1890*: E. Siret/L. Siret, *Las primeras edades del metal en el sudeste de España* (Barcelona 1890).
- Stos-Gale et al. 1999*: Z. Stos-Gale/M. A. Hunt Ortiz/N. H. Gale, Análisis elemental y de isótopos de plomo de objetos metálicos de Gatas. In: P. Castro/R. W. Chapman/S. Gili/V. Lull/R. Micó/C. Rihuete/R. Risch/M. E. Sanahuja, *Proyecto Gatas 2. La dinámica arqueológica de la ocupación prehistórica* (Sevilla 1999) 347–358.
- Tornos/Chiaradia 2004*: R. Tornos/M. Chiaradia, Plumbotectonic Evolution of the Ossa Morena Zone. Iberian Peninsula. Tracing the Influence of Mantle-Crust Interaction in Ore-Forming Processes. *Economic Geology* 99, 2004, 965–985.

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The Bronze Age in the Lands of Antequera

On the Wake of a Powerful Past

Keywords: Bronze Age, Lands of Antequera, megaliths, megalithic cists, hypogea, settlement dynamics, metallurgy, cultural continuity

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Abstract

Antequera is home to a major megalithic site, listed in the UNESCO World Heritage List since July 2016. Although going back to the first half of the 19th cent. CE, research on this site has hitherto failed to provide a thorough synthesis of the settlement

dynamics in the Later Prehistory of the surrounding region, the Lands of Antequera. In line with the topic of this book, in this contribution a review of the currently available evidence for Bronze Age Antequera is presented. This is a follow-up of a similar paper dealing with the Copper Age, published some years ago (García Sanjuán et al. 2016). To achieve this review, a summary description of the available empirical evidence is first made; then, the main trends of that period in terms of settlement patterns, economic practices and funerary ideology are discussed; finally, the resulting conclusions are put into a more general perspective from the view point of the social and cultural dynamics of southern Iberian Bronze Age. The resulting picture is that the Bronze Age at the Lands of Antequera appears to have been visibly marked by a phenomenon of cultural continuity pivoting around the persistent influence of the magnificent megalithic monuments that dominated the social landscape in the 4th and 3rd mill. BCE.

1. Introduction

Interest on the Later Prehistory of the Lands of Antequera¹ goes back to the first half of the 19th cent. CE, when the first scientific description of the Menga dolmen was published by Rafael

¹ The territory of the Lands of Antequera (2640km²) includes the municipalities of Alameda, Alfarnate, Alfarnatejo, Almargen, Almogía, Antequera, Archidona, Ardales, Campillos, Cañete la Real, Carratraca, Casabermeja, Colmenar, Cuevas Bajas, Cuevas del Becerro, Cuevas de San Marcos, Fuente de Piedra, Humilladero, Mollina, Periana, Sierra de Yeguas, Teba, Valle de Abdalajis, Villanueva de Algaidas, Villanueva de Tapia, Villanueva del Rosario and Villanueva del Trabuco.

Mitjana y Ardison (1847). The discovery of Viera and El Romeral at the turn of the 20th cent. CE led to a renewed interest on the site, as reflected in several publications (Velázquez Bosco 1905; Gómez Moreno Martínez 1905; De Mergelina 1922; Hemp 1934; Leisner/Leisner 1943). The Spanish Civil War and subsequent poverty of resources, human and material, during the Franco dictatorship caused research to grind to a halt for over sixty years. At the end of the 1980s academic research was resumed and continued through the first two decades of the 21st cent. CE with projects run by the universities of Málaga (1986–1995), Granada (2005–2006) and Sevilla (2013–2021). In recent years major advances have been made in two areas hitherto poorly known: the landscape dimension and territorial background of the megalithic monuments on the one hand (see for example García Sanjuán 2009; García Sanjuán/Wheatley 2009; García Sanjuán et al. 2010; 2016; 2021; Rogerio-Candelera et al. 2018; Díaz-Guardamino Uribe et al. 2020) and their complex biographies on the other hand (see among others García Sanjuán/Lozano Rodríguez 2016; Bradley/García Sanjuán 2017; García Sanjuán/Mora Molina 2018; García Sanjuán et al. 2019; Mora Molina 2019). The advances achieved by recent (and ongoing) research were of key importance towards the inclusion of the site in the UNESCO World Heritage List in July 2016.

However, despite recent progress, there remain significant areas for which the scientific knowledge of Antequera's Later Prehistory is fairly limited to say the least. One of them is the Bronze Age, a period for which, to this date, no synthesis exists. This is to some extent surprising, given the importance that Bronze Age studies have had in neighbouring Andalusian regions such as the southeast (Almería and Granada) or the Guadalquivir Valley (Jaén, Córdoba and Sevilla) (see for example Lull Santiago 1983; Aubet Semmler et al. 1983; Castro Martínez et al. 1999; Contreras Cortés et al. 2000; Schubart et al. 2000; Aranda Jiménez et al. 2015). Probably, this absence can be best explained by the inordinate (if, arguably, understandable) prominence held by the outstanding megalithic monuments dating to the 4th and 3rd mill. BCE, which has somehow eclipsed the study of the Bronze Age in the region.

In line with the title of this volume, the main aim of this paper is to review the currently available evidence for the study of Bronze Age Antequera. The approach followed here is much the same as the one presented in a recent paper dealing with settlement patterns and social dynamics in the Copper Age (García Sanjuán et al. 2016). To this end, the literature on the Later Prehistory in the region, which currently encompasses 16 monographs and almost 400 journal papers and contributions in edited volumes and conference proceedings, has been reviewed. To that, a substantial amount of 'grey literature', including dozens of unpublished fieldwork reports (surveys, excavations, etc.) as well as some academic dissertations, must be added. The basic information about the sites included in this review is stored in the ARCA database (<http://institucional.us.es/arca/>), designed and maintained by the University of Sevilla's research group ATLAS (Moreno Escobar/García Sanjuán 2013). This database currently includes data of 1716 sites located in all the municipalities within the Lands of Antequera, from the Middle Palaeolithic to Modern History.

To achieve this review, first an overall description of the available empirical evidence will be made followed by a discussion in terms of settlement patterns, economic and social dynamics as well as burial practices and ideology; finally, the resulting conclusions will be put into a more general perspective from the view point of the social and cultural processes of the Bronze Age.

2. Evidence

The ARCA database currently includes 181 Bronze Age sites for the Lands of Antequera (*fig. 1*). Of them, 19 have been researched archaeologically, including seven settlements (Aratispi, Castillo de Antequera, El Castillejo, Huerta de Peñarrubia, La Capellanía, Los Castillejos and Yacimiento 129), seven burial sites (Alcaide, El Tardón, Las Aguilillas, Morenito I, Rodahuevos, Torre del Cuchillo and Viera), four mixed sites (caves of Ardales, El Toro and La Pulsera as well as open air sites such as La Peña de los Enamorados and La Galeota) and one 'warrior' stela (Almargen) (*table 1* and *fig. 2*). Of the 19 best-known sites, 14 were excavated (Alcaide,

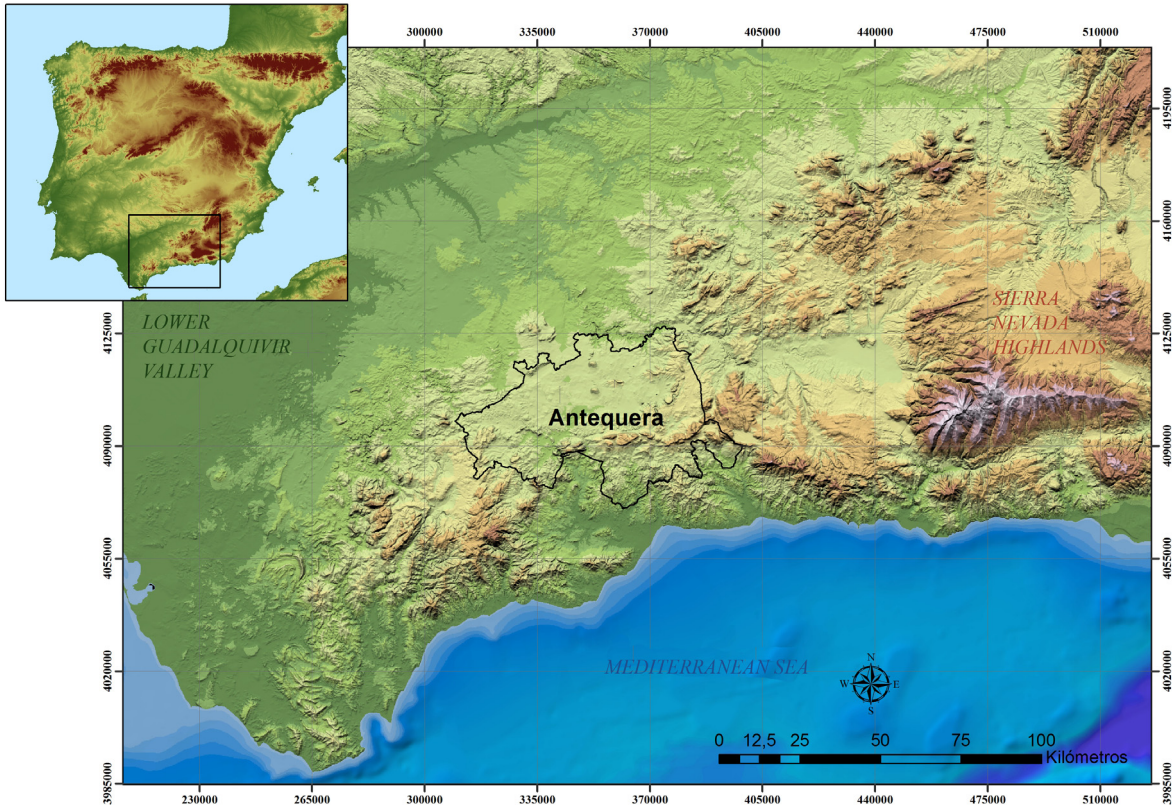


Fig. 1. Location map of Antequera in southern Iberia (design by María del Carmen Moreno Escobar and Leonardo García Sanjuán).

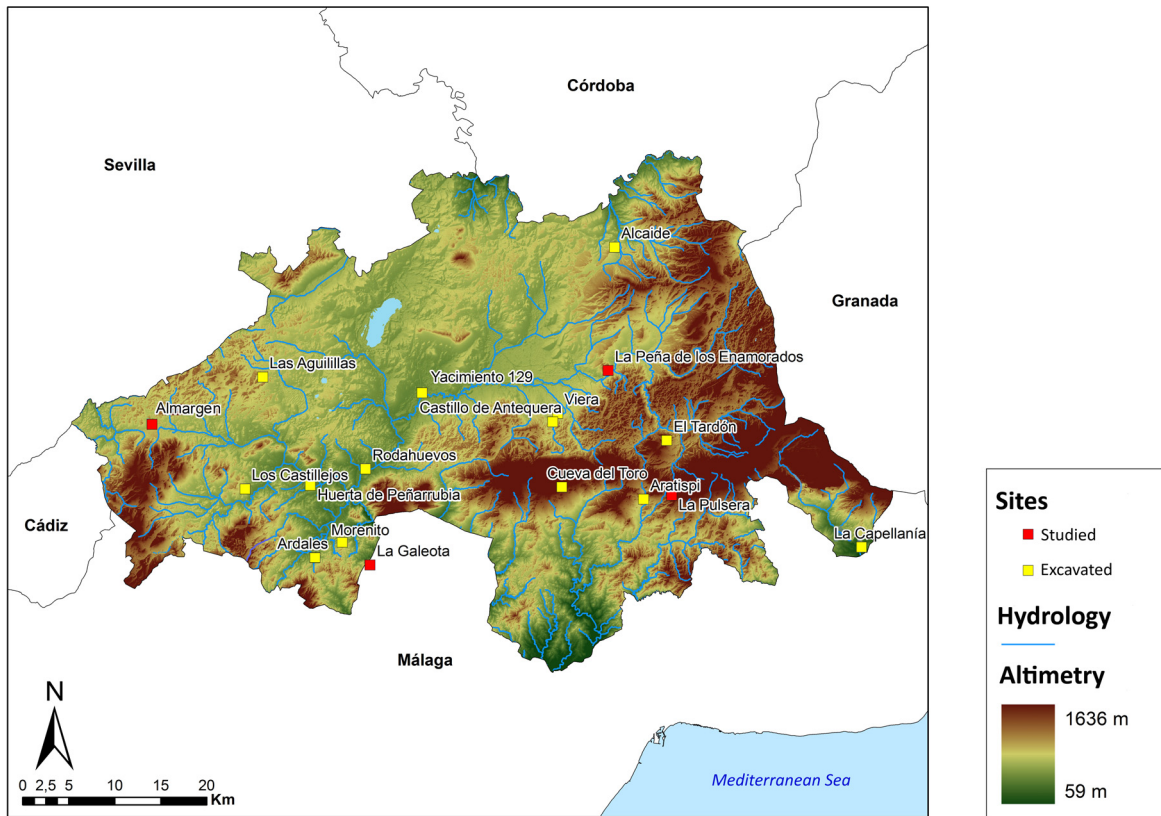


Fig. 2. Location map of Bronze Age sites in the Lands of Antequera (design by María del Carmen Moreno Escobar and Leonardo García Sanjuán).

Site	Municipality	Period	Type	Source	Bibliographic References
Alcaide	Antequera	CA/EBA/ LBA	Burial	Excavation	Aguado Mancha et al. 1997; 2002; Marqués Merelo 1983; 1987; 1992; Marqués Merelo/Ferrer Palma 1979; 1983; Marqués Merelo et al. 1992; Márquez Romero/Marqués Merelo 1997
Almargen	Almargen	LBA	ND	Survey	Vilaseca Díaz 1993; Díaz-Guardamino Uribe et al. 2020
Aratispi	Antequera	N/LBA/EIA	Settlement	Excavation	Perdiguero López 1989; 1990; 1992; 1994; 1998
Castillo de Antequera	Antequera	LBA/EIA	Settlement	Excavation	Romero Pérez/Fernández Rodríguez 2012
El Castillejo	Almogía	LBA	Settlement	Excavation	Fernández Rodríguez/Rodríguez Venceiro 1995
El Tardón	Antequera	EBA	Burial	Excavation	Ferrer Palma et al. 1987; Fernández Ruiz et al. 1997
El Toro	Antequera	N/CA/LBA	Settlement/ Natural cave	Excavation	Martín Socas et al. 2004
Huerta de Peñarrubia	Campillos	LBA	Settlement	Survey	García Alfonso 1999
La Capellanía	Periana	N/CA/LBA/ EIA	Settlement	Excavation	Martín Córdoba/Recio Ruiz 2004
La Galeota	Ardales	CA/BA	Settlement/ Lithic workshop	Survey	Espejo Herrerías et al. 1990
La Peña de los Enamorados	Antequera	CA/BA	Settlement/ Burial	Survey	Moreno Aragón/Ramos Muñoz 1983; Rodríguez Venceiro et al. 1992; Suárez Padilla et al. 1995
La Pulsera	Antequera	N/CA/BA	Settlement/ Burial	Survey	Leiva Riojano/Ruiz González 1977
Las Aguillilas	Antequera	BA	Burial	Excavation	Ramos Muñoz et al. 1995; 1997; 1999; Macías López 1995
Los Castillejos	Teba	EBA/EIA	Settlement	Excavation	García Alfonso 1994; 1996
Morenito I	Ardales	EBA	Burial	Excavation	Ramos Muñoz et al. 1987; 1989
Rodahuevos	Antequera	EBA	Burial	Excavation	Fernández Rodríguez et al. 1999
Torre del Cuchillo	Antequera	LBA	Burial	Excavation	Fernández Rodríguez et al. 2013
Viera	Antequera	N/CA/EBA	Burial/Ritual	Excavation	Aranda Jiménez et al. 2013
Yacimiento 129	Bobadilla	EBA	Settlement	Excavation	Fernández Rodríguez 2005

Table 1. Bronze Age sites in the Lands of Antequera studied through excavation or surface survey. N: Neolithic; CA: Copper Age; BA: Bronze Age; EBA: Early Bronze Age; LBA: Late Bronze Age; EIA: Early Iron Age.

Aratispi, Castillo de Antequera, El Castillejo, El Tardón, El Toro, La Capellanía, Las Aguilillas, Los Castillejos, Morenito I, Rodahuevos, Torre del Cuchillo, Viera and Yacimiento 129) while the remaining five are known only through surveys and/or studies of surface materials (Almargen, Huerta de Peñarubia, La Galeota, La Peña de los Enamorados and La Pulsera). In addition, there is a small series of sites located at the confluence of the Turón and Guadalhorce rivers for which Bronze Age occupation is likely, although no confirmatory evidence in the form of radiocarbon dates is available.

2.1. Settlements

There are seven excavated settlements for which Bronze Age occupation has been reported. The site of Aratispi, which was inhabited in the Copper Age, seems to have been abandoned in the Early Bronze Age, to then be reoccupied in the Late Bronze Age.² This Late Bronze Age phase of occupation was well reflected in the assemblage of ceramic materials retrieved at the site, but no associated substantial architectural remains were identified (Perdiguero López 1992, 32).

At La Capellanía (Periana), excavations undertaken in 1986 and 1987 revealed a similar sequence of occupation: inhabited in the Copper Age, abandoned in the first half of the 2nd mill. BCE and then occupied again in the Late Bronze Age. The reoccupation of the site in the Late Bronze Age largely exceeded the habitation area of the Copper Age, sprawling not only over the entire hilltop but also on the northern and southern slopes. In this period, the site was enclosed by a 1.7m thick perimetral wall made following a constructive technique very different from that of the Copper Age (Martín Córdoba 1994, 6). The excavations unearthed an unspecified number of huts built by means of short and thin walls of stone masonry roofed by timber and perishable materials coated with sun-dried mud, and with floors made

with fired clay or flat and regular pebbles (Martín Córdoba 1994, 6). The material culture found in these dwellings included basically pottery vessels such as large pots, storage jars and carinated vessels, as well as knapped lithics not unlike those of the Copper Age.

The excavations carried out at El Castillejo (Almogía) in 1993 led to the discovery of a settlement which, like Aratispi and La Capellanía, had been occupied in the Copper Age, then discontinued in the Early Bronze Age, and then occupied again the Late Bronze Age. However, no architectural remains were attributed to the later phase of occupation, which does not seem to have been very substantial (Fernández Rodríguez/Rodríguez Vinceiro 1995, 68).

A sondage pit excavated in 1993 at the Iron Age site of Los Castillejos (Teba) unearthed some hand-made ceramic materials the excavators dated to the second half of the 2nd mill. BCE (García Alfonso 1994, 67). No further evidence exists for the occupation of this site during that period, as all architectural remains discovered (including dwellings and a perimetral wall) were dated to the Early Iron Age in connection with the Phoenician colonial presence along the Málaga coast (García Alfonso 1994, 67).

Various excavations undertaken since 2000 at the Antequera Castle as part of restoration projects led to the identification of artefacts that the excavators interpreted as resulting from a Late Bronze Age occupation. As in the case of Aratispi, El Castillejo or Los Castillejos, no architectural remains of this period were found (Romero Pérez/Fernández Rodríguez 2012, 273).

In 2002, excavations carried out at Yacimiento 129 (Antequera) in connection with the Antequera-Granada high-speed railway link, led to the discovery of a Late Bronze Age settlement. According to the published report, the site yielded some material culture and remains of light architecture made with perishable materials. Coupled with the fact that the site was located on low ground, the available evidence suggested a single-phase of temporary or seasonal occupation (Fernández Rodríguez 2005, 91).

At the El Toro cave (Antequera), a single radiocarbon date (2880 ± 50 BP, 1260–910 calBCE 2σ)

² In line with our previous work, the term Early Bronze Age will be applied to those sites dated to between the 23rd and 16th cent. calBC and Late Bronze Age to those dated to between the 16th and 9th cent. calBC.

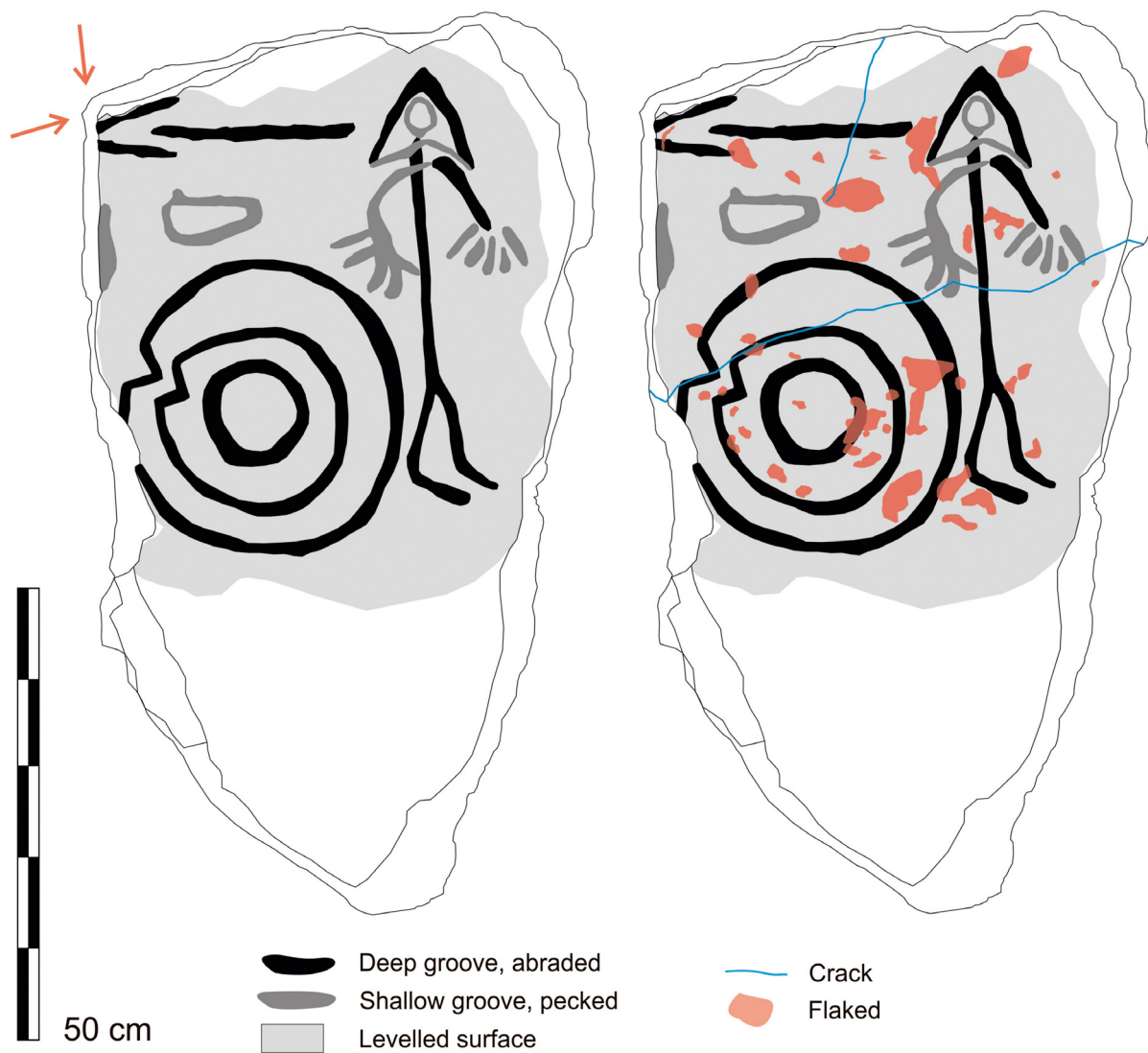


Fig. 3. Almargin 'warrior' stela (from: Díaz-Guardamino Uribe et al. 2020, 10).

(GrN-15446), suggests a possible frequentation or sporadic presence in the Late Bronze Age, but precise evidence of the activity this date represents was not found.

Apart from these seven Bronze Age sites for which some kind of evidence was obtained during excavation, survey work (in some cases coupled with studies of material culture) has suggested the existence of a number of other sites. This is the case of Huerta de Peñarrubia (Campillo) (García Alfonso 1999, 362; Romero Pérez/Fernández Rodríguez 2012, 271) and various other sites at the confluence of the Turón and Guadalhorce rivers, including El Calvario, El Cerrajón, La Peña de Ardales, Raja del Boquerón, Lomas del Infierno,

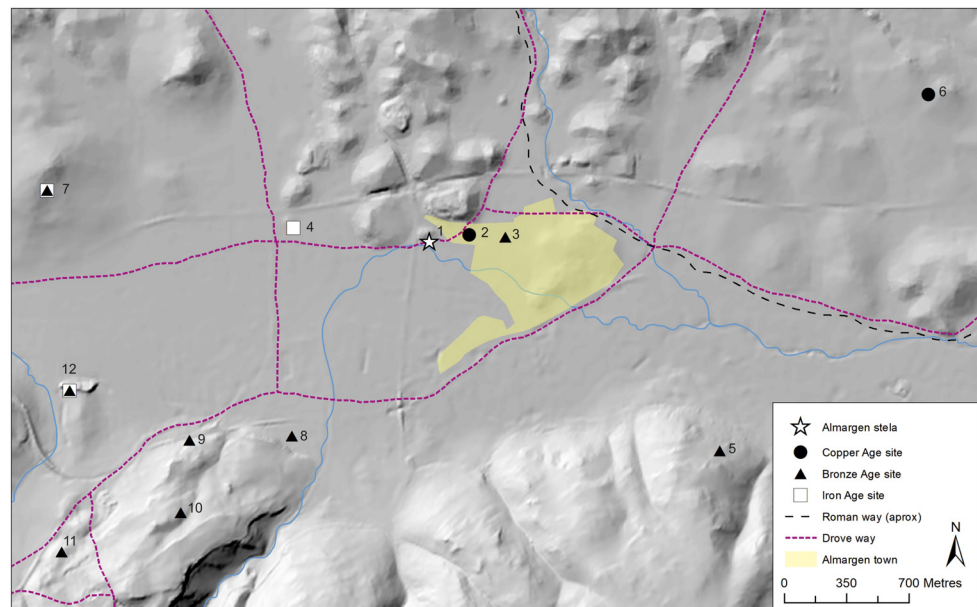
Parque de Ardales, Pico Vado Real and others (Martín Córdoba et al. 1992). No precise data about the chronology or nature of their occupation exists for any of them.

Finally, a site that has yielded significant evidence for the study of the Bronze Age in the Lands of Antequera is Almargin, where a 'Huelva-type' sword and a 'warrior' stela were discovered (Vilaseca Díaz 1990; 1993; Díaz-Guardamino Uribe et al. 2020). The stela was found by chance just outside the modern town of Almargin, on the road to Olvera and 700m away from the site of Las Madrigueras, where an excavation undertaken in 1992 yielded a substantial amount of architectural remains and material evidence dated



Fig. 4. Location map of Almargin finds and sites:

- (1) 'Warrior' stela;
 - (2) Almargin 'idol';
 - (3) Huelva-type sword;
 - (4) Las Madrigueras;
 - (5) Haza del Almirón;
 - (6) Arroyo La Rana;
 - (7) Cerro de Las Rosas;
 - (8) Ladera Majavea;
 - (9) Plataforma las Ventanas;
 - (10) Espolón de las Ventanas;
 - (11) Cueva Arroyo Dehesa;
 - (12) Herriza Arroyo Sourcezuela
- (from: Díaz-Guardamino Uribe et al. 2020, 29).



by the excavators to the Early Iron Age, a point later corroborated by two radiocarbon dates (Díaz-Guardamino Uribe et al. 2020, table 4). This stela, depicting an anthropomorph together with a circular shield, a spear and some kind of headgear (perhaps a conical helmet) is the only of its kind in Mediterranean Iberia (*fig. 3*). The 'Huelva-type' sword was also found by chance just outside Almargin (Vilaseca Díaz 1993, 221). It is important to note that, barely a few hundred metres from where the stela and the sword were found, another important discovery was made, also by chance: the so-called 'Almargin idol' (Vilaseca Díaz 1994). This 'idol' is a sculpture carved in stone that, on account of its large size and morphology, stands

out among the plastic creations of the Late Neolithic and Copper Age in southern Iberia (García Pérez et al. 2020, 253) (*fig. 4*). The concentration of exceptional finds, such as the idol, the sword and the stela, suggests that Almargin played an important role in the territorial organisation of late prehistoric communities in the Lands of Antequera. This is very likely partly connected with fact that Almargin lies at a very special geostrategic position, hinging right on the watershed between the Mediterranean and Atlantic hydrological basins, which probably made it a pivotal node in the communication between the Malaga coast and the Guadalquivir valley, along the Corbones river, in the Late Bronze and Early Iron Age.

Site	BP	Lab. Code	BCE (1 σ)	BCE (2 σ)	Sample	Context	Bibliographic References
La Capellanía	3750 ± 120	Ly-4197	2350–1970	2550–1750	Not available	Settlement	Rodríguez Vínceiro/Márquez Romero 2003
Ardales	3747 ± 40	COL-1641	2265–2046	2286–2034	Bone (undetermined)	Hypogeum	Rethemeyer 2014
El Tardón (Tomb B)	3745 ± 25	GrN-16066	2200–2060	2275–2039	Bone (human)	Megalithic cist	Fernández Ruiz et al. 1997
Ardales	3718 ± 40	COL-1640	2196–2037	2275–1980	Bone (undetermined)	Natural cave	Rethemeyer 2014
Ardales	3715 ± 40	COL-1642	2195–2036	2275–1978	Bone (undetermined)	Natural cave	Rethemeyer 2014
Ardales	3621 ± 35	COL-1637	2031–1936	2126–1890	Bone (undetermined)	Natural cave	Rethemeyer 2014
Viera	3580 ± 30	Beta-353822	1950–1890	2020–1880	Bone (<i>Cervus elaphus</i>)	Megalith	Aranda Jiménez et al. 2013
El Tardón (Tomb A)	3530 ± 60	UGRA-260	1940–1740	2040–1680	Bone (human)	Megalithic cist	Fernández Ruiz et al. 1997
Alcaide (#14)	3475 ± 40	CNA-14096	1878–1746	1985–1690	Bone (human)	Hypogeum	Tovar Fernández et al. 2014
Alcaide (#15)	3340 ± 90	GrN-16064	1740–1510	1880–1430	Bone (human)	Hypogeum	Baldomero Navarro 2001
Torre del Cuchillo	3250 ± 30	Beta-526360	1607–1461	1612–1451	Bone (human)	Megalith	This paper
Alcaide (#14)	3180 ± 100	GrN-16061	1610–1310	1750–1100	Bone (human)	Hypogeum	Baldomero Navarro 2001
Torre del Cuchillo	3160 ± 30	Beta-526361	1494–1411	1501–1323	Bone (human)	Pit	This paper
Alcaide (#14)	3115 ± 40	CNA-14097	1433–1304	1494–1269	Bone (human)	Hypogeum	Tovar Fernández et al. 2014
El Toro	3090 ± 130	UGRA-189	1500–1130	1700–950	Charred material (undetermined)	Natural cave	Martín Socas et al. 2004
Alcaide (Pit B)	3090 ± 60	GrN-19199	1422–1280	1498–1208	Bone (human)	Pit	Marqués Merelo/Aguado Mancha 2012, 52
Alcaide (#14)	3045 ± 40	CNA-14098	1387–1234	1414–1135	Bone (human)	Hypogeum	Tovar Fernández et al. 2014
Alcaide (#14)	2945 ± 40	CNA-14099	1220–1060	1263–1023	Bone (human)	Hypogeum	Tovar Fernández et al. 2014
Alcaide (#15)	2910 ± 100	GrN-16063	1270–970	1400–850	Bone (human)	Hypogeum	Baldomero Navarro 2001
Alcaide (#15)	2880 ± 150	GrN-16065	1261–900	1439–796	Bone (human)	Hypogeum	Marqués Merelo/Aguado Mancha 2012, 47
El Toro	2880 ± 50	GRN-15446	1190–940	1260–910	Charred material (undetermined)	Natural cave	Martín Socas et al. 2004
Yacimiento 129	2785 ± 45	Ua-23136	1000–840	1050–820	Charred material (undetermined)	Settlement	Romero Pérez/Fernández Rodríguez 2012

Table 2. Radiocarbon dates published for Bronze Age sites in the Lands of Antequera.



Fig. 5. Alcaide. Hypogeum 14: access corridor (1986 excavations) (from: Tovar Fernández et al. 2014, 129).

2.2. Burial Sites

Evidence of Bronze Age burial activity has been identified at six sites, in all cases through excavation. Two of them are hypogea (Alcaide and Las Aguilillas), three are megalithic cists (Morenito I, El Tardón and Rodahuevos) and the last one corresponds to a reuse of the Viera dolmen.

The site of Alcaide includes a necropolis of hypogea (or ‘artificial caves’, as they are often referred to in the Spanish literature) first excavated by Simeón Giménez Reyna in the 1950s (Giménez Reyna 1946; 1953), and then by the University of Málaga in several seasons extending between the 1970s and 1990s (Aguado Mancha et al. 1997; 2002; Marqués Merelo 1983; 1987; 1992; Marqués Merelo/Ferrer Palma 1979; 1983; Marqués Merelo et al. 1992; Márquez Romero/Marqués Merelo 1997; Tovar Fernández et al. 2014). Although predominantly used in the 3rd mill. BCE (Copper Age), six out of the 21 excavated burials, specifically

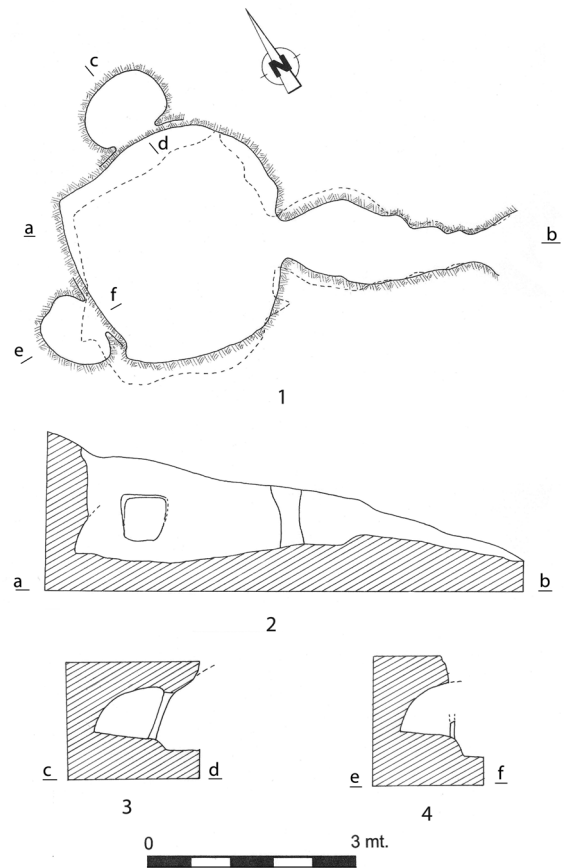


Fig. 6. Alcaide. Hypogeum 14: plan and section (from: Tovar Fernández et al. 2014, 131).

those designated as hypogea #9, #12 (early #7), #14 and #15 and burial pits A and B, were used (and probably built) in the Bronze Age. The Bronze Age chronology of those six tombs is suggested by the material culture found in them as well as eight radiocarbon dates, five from Tomb #14 and three from Tomb #15 (*table 2*).

Hypogeum #14 has a simple 3.2m long and 1.4m wide access corridor leading to a 3.3m wide and 0.6m high circular-plan chamber cut into the bedrock. This chamber opens to an annex chamber (1.22m in width, 0.84m in depth and 0.7m in height) and a niche (1.1m in width, 0.7m in depth and 0.7m in height) (*fig. 5–6*). Numerous highly fragmented human bones were found, amounting to a minimum number of 32 individuals,³ including five non-adults, seven adult women

³ A previous publication mentions a MNI of 33 (Marqués Merelo/Aguado Mancha 2012, 45).

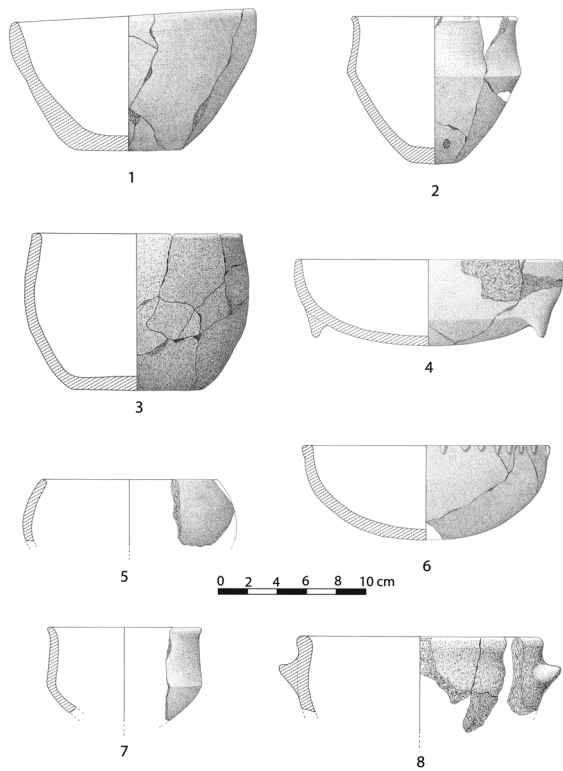


Fig. 7. Alcaide. Hypogeum 14: grave goods (from: Tovar Fernández et al. 2014, 135).

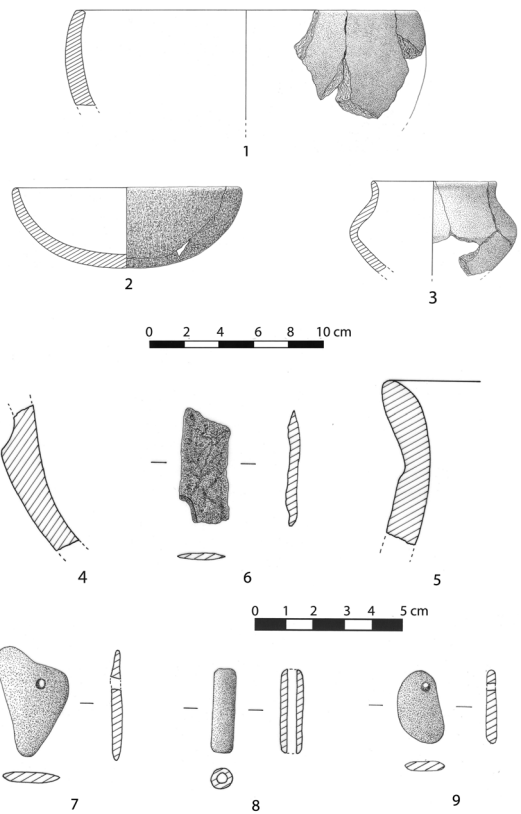


Fig. 8. Alcaide. Hypogeum 14: grave goods (from: Tovar Fernández et al. 2014, 136).

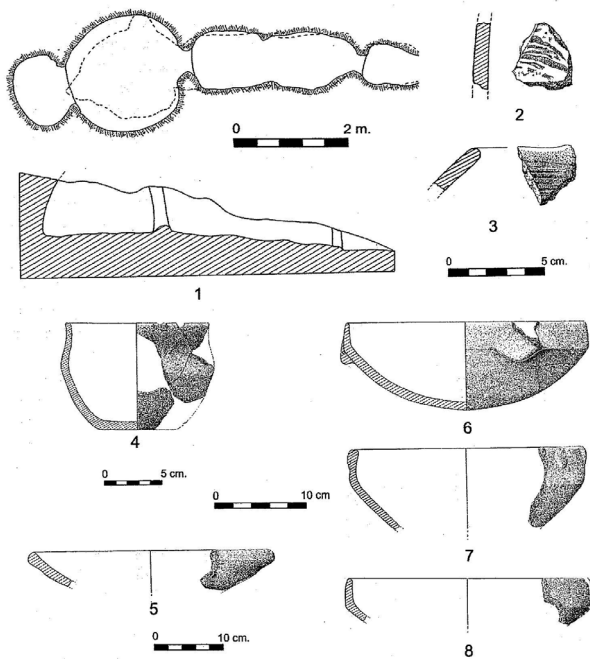


Fig. 9. Alcaide. Hypogeum 15: plan, section and grave goods (from: Marqués Merelo/Aguado Mancha 2012, 46).

and five adult men, which seems to be a representative sample of the natural population (Tovar Fernández et al. 2014). Five radiocarbon dates, all of human bone, date these internments to the Bronze Age, including one dating to the first half and four to the second half of the 2nd mill. BCE. The grave goods are generally in line with the technology and style of Bronze Age material culture (*fig. 7–8*).

Hypogeum #15 presents a 4m long corridor leading to a circular chamber fully cut into the bedrock, and 2m in diameter, the roof of which had collapsed, with an annex chamber at the opposite end (Marqués Merelo/Aguado Mancha 2012, 45–48) (*fig. 9*). The estimated Minimum Number of Individuals (MNI) for this tomb is 15, although no anthropological report has ever been published. All three radiocarbon dates obtained from this tomb (all of them from samples of human bone) yielded ages set in the Bronze Age: one in the second quarter and two in the second half of the

2nd mill. BCE (table 2). Ceramic vessels deposited as grave goods show styles compatible with a Late Bronze Age date.

Alcaide's hypogeum #9 was first excavated by Simeón Giménez Reyna and later re-excavated by the University of Málaga in 1976 (fig. 10) (Marqués Merelo 1983; Marqués Merelo/Aguado Mancha 2012, 48 f.). From an architectural point of view, this tomb has a 2.1m long corridor that descends towards a circular-plan vaulted chamber 2.7m in diameter and fully cut into the bedrock. In terms of material culture, although the excavators claimed the tomb had been partly looted, the list of recorded grave goods includes a ring, two beads, and a diadem, all in silver, a punch and two arrowhead fragments in copper, a flake and a sickle-blade element in stone (Marqués Merelo 1983, 159 f.) and various fragments of ceramic vessels (Marqués Merelo/Aguado Mancha 2012, 49). No radiocarbon dates (or anthropological reports) are available for this tomb, but its use in the Bronze Age is beyond any doubt, given the presence of four silver objects, including, especially the diadem. This silver diadem is, together with the one found in Tomb II-2 at the La Papúa settlement (Huelva) (García Sanjuán 1999), the only example of its kind ever found outside the southeastern Spanish provinces of Almería (Vera basin) and Murcia, where, to this date, only eight of them have been recorded at Argaric sites such as El Oficio, Gatas, Fuente Álamo, El Argar or La Almoloya.

Hypogeum #12 (designated as #7 in earlier publications) (fig. 11) yielded evidence of Copper Age as well as Bronze Age use (Marqués Merelo/Ferrer Palma 1979, 84). Two arsenical copper daggers, one of them riveted, and the other with lateral notches were attributed to the Early Bronze Age (ca. 2200–1550 BCE) (Marqués Merelo/Aguado Mancha 2012, 50).

Two burial pits identified alongside the 21 hypogea were also dated to the Bronze Age. Burial Pit B is circular in plan, 1.7m across and with a depth of 0.3m. Inside, the remains of three inhumed individuals with no grave goods were found (Marqués Merelo/Aguado Mancha 2012, 52). A radiocarbon date obtained on a bone sample taken from one of these individuals (GrN-19199)



Fig. 10. Alcaide. Hypogeum 9: access corridor and entrance to main chamber (2006 survey) (photo by Leonardo García Sanjuán).

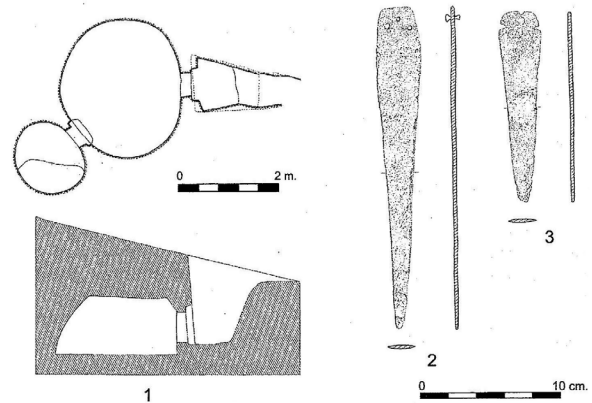


Fig. 11. Alcaide. Hypogeum 12: plan, section and grave goods (from: Marqués Merelo/Aguado Mancha 2012, 51).

places this feature in the third quarter of the 2nd mill. BCE (1498–1208 BCE 2σ).

Another major hypogeic necropolis used in the Bronze Age is Las Aguilillas (municipalities of Ardales and Campillos), excavated in February 1994 by a joint team from the Ardales Museum, the University of Cádiz and the Diputación of Málaga (Ramos Muñoz et al. 1995; 1997; 1999; Macías López 1995). In total, seven hypogea were excavated. Table 3 offers a descriptive summary of all seven structures. Those designated #1, #2, #3, #4, #5 and #7, display fairly similar characteristics, while #6 is clearly differentiated from the rest in its marked 'hybrid' megalithic-hypogeic character.

Plan	Maximum Diameter	Maximum Height	Additional Spaces	Megalithic Slabs	Rock Art	Minimum Number of Individuals	Special Finds
#1	3.10m	1.95m	Two small niches	At the start of the corridor or ante-chamber there are two grooves for the placement of door slabs	One anthropomorphic figure in fine incised lines	1 (1 undetermined)	NA
#2	3.20m	1.60m	Access corridor in L; ante-chamber of almost-irregular plan and lateral niche. The main chamber has two lateral niches with pseudo circular plan	No	No	1 (1 undetermined)	In one of the niches, more than 50 stone picks were found (presumed to have been used for the quarrying of the hypogeum)
#3	NA	NA	No	No	On the upper side several cup-marks grouped in rows and an anchorform	1 (1 undetermined)	NA
#4	3.65m	1.5m	Four lateral niches with pseudo-oval plan and dome-like roofing	No	No	18 (twelve undetermined, two males, four females)	NA
#5	2.20m	1.54m	Two lateral niches with oval plan	No	No	20 (15 undetermined, two males, three females)	NA
#6	14m	1.90m	Access corridor (7.59m in length), first chamber (4m maximum length), second corridor (0.75m) and second chamber (1.95m in length); total length: 14m; length inner spaces: 8.10m	Several capstones	No	1 (one male)	NA
#7	3.70m	No roof	Small drainage groove	No	No	1 (one female)	

Table 3. General description of hypogea #1–7 at Las Aguilillas (from: Ramos Muñoz et al. 1995; 1999); NA: Not available.



Fig. 12. Las Aguilillas. Hypogeum 3 (photo by Miguel Ángel Blanco de la Rubia).



Fig. 13. Las Aguilillas. Hypogeum 2 (photo by Miguel Ángel Blanco de la Rubia).



Fig. 14. Las Aguilillas. Hypogeum 6 (photo by Miguel Ángel Blanco de la Rubia).

Typically, structures #1, #2, #3, #4, #5 and #7 display an oval or irregular plan, with a main chamber between 2.2 and 3.7m across and between 1.7 and 1.9m in height, with secondary chambers or niches (*fig. 12–13*). Two of the hypogea present graphic motifs: an anthropomorphic figure in Tomb #1 and some cup-marks and an ‘anchoriform’ motif in Tomb #3. Structure #6, on the other hand, is a semi-megalithic hypogeum with corridors and chambers cut into the bedrock and then roofed by large capstones and is larger in size, with 14m in total length, including a 7.5m long access corridor, a main chamber (4m in length) and a secondary corridor and chamber (0.7 and 2m in length respectively) (*fig. 14–16*).

The anthropological study of the 1994 excavation reports 7067 fragments of human bone (including 920 fragments of skulls), of which only 771 were identified anatomically, plus 360 teeth, amounting to a MNI of 51 for all seven hypogea (Macías López 1995, 167). By sex, five male and three female individuals were identified,

while by age, one neonate, five infants, seven juveniles, 22 young adults and four adults were listed (Macías López 1995, 167 f.). In terms of material culture, the available publications do not list all finds by tomb, and provide only a general discussion. Ceramic vessels included simple shapes (large bowls, carinated vessels, thick-rim



Fig. 15. Las Aguilillas. Hypogeum 6 (photo by Miguel Ángel Blanco de la Rubia).



Fig. 16. Las Aguilillas. Hypogeum 6 (photo by Miguel Ángel Blanco de la Rubia).

plates, etc.) while an abundant and diversified assemblage of lithics included three bifacially-knapped foliaceous points, pressure-knapping blades, scrapers, denticulates and sickle blade lithics. Other elements of material culture include two arsenical copper punches, five perforated beads made in shell as well as over 200 heavy-duty picks and maces made in flint, sandstone and siliceous sandstone. Only in the niche next to the antechamber of Tomb #2 over 50 such picks were recovered. According to the excavators, the large amount of these macro-lithic tools could be explained as a result of the quarrying work involved in the construction of the tombs themselves. A substantial faunal assemblage was also recovered, including 219 identifiable remains of domestic animals such as bovids, ovicaprids, pigs and dogs, as well as wild animals, including deer, rabbit, hare, fox, various types of birds and marine molluscs such as *Unio pictorum*, *Cerastoderma edule* and *Pecten maximus* (Ramos Muñoz et al. 1995, 161).

According to the excavators, the deposition pattern of human remains and grave goods was best observed in Tombs #4 and #5 (Ramos Muñoz et al. 1995, 154). In Tomb #4 a single layer of burial was recorded, with bones of 18 individuals (twelve indeterminate, two men and four women) and a carefully-arranged distribution of skulls between stones (Ramos Muñoz et al. 1995, 162), which suggested a possible organisation of the bodies in a radial pattern, with the heads close to the walls of the chamber and bodies and legs pointing towards the centre, although the scarcity of postcranial bones makes this hypothetical (Macías López 1995, 170). In connection with each of the skulls, simple ceramic bowls and some stone picks were found (Ramos Muñoz et al. 1995, 162). Both copper punches were also retrieved from this tomb.

On the basis of pottery types, the Las Aguilillas hypogea were dated by their excavators to the Bronze Age (Ramos Muñoz et al. 1995; 1999). However, given that this has not been corroborated yet



Fig. 17. El Tardón. Structure B (photo by Ignacio Marqués Merelo).

by radiocarbon determinations and considering that several elements of the material culture found in the tombs (not least the bifacially-knapped foliaceous points and pressure-knapping blades) are more compatible with chalcolithic burial assemblages than with Bronze Age ones, caution is necessary when assessing the chronology of these remarkable hypogea. It is not entirely impossible that, just like Alcaide, Las Aguilillas also experienced a long history of use throughout the 3rd and 2nd mill. BCE.

Excavations carried out in November 1984 and July 1985 at El Tardón (Antequera) led to the discovery of two megalithic cists with collective inhumations that were dated to the Early Bronze Age (Ferrer Palma et al. 1987; Fernández Ruiz et al. 1997). Structure A, 5m in length, 1.1m in width and 1m deep, showing a roughly rectangular plan, contained the remains of 16 individuals, including six male adults, five adult females and five non-adults. A sample of human bone from this tomb (UGRA-260) yielded an age of 3530 ± 60 BP (2040–1680 BCE 2σ). Structure B was very similar: rectangular plan, 5m in length, 1.4m in breadth and 0.5m of maximum depth, but with transversal slabs delimiting different spaces inside the chamber (fig. 17–18). A minimum number of 17 individuals were found in this tomb, including five male and six female adults as well as six non-adults. Most of the human bones were found in anatomical connection. A sample of



Fig. 18. El Tardón. Structure B (photo by Ignacio Marqués Merelo).

them yielded a radiocarbon age of 3745 ± 25 BP (2275–2039 BCE 2σ) (GrN1–16066). Numerous elements of material culture were collected, including several fragments of pottery, some with Bell-Beaker decoration (of unspecified style),



Fig. 19. Morenito I. General view (photo by Pedro Cantalejo Duarte).



Fig. 21. Morenito I. Grave goods (photo by Pedro Cantalejo Duarte).



Fig. 20. Morenito I. Detail of chamber (photo by Pedro Cantalejo Duarte).

an 8cm long stone wrist-guard with three perforations on each end, four copper objects, including a dagger blade, a punch, an axe and a Palmela-type arrowhead, as well as several personal ornaments mainly manufactured on shells of marine molluscs ‘three *Columbellae rusticatae*, one *Pecten maximus* and a discoidal perforated bead’ (Fernández Ruiz et al. 1997, 377).

A similar megalithic cist, built with large uprights and trapezoidal in plan, was excavated in September 1986 at the site of Morenito I (Ardales) (fig. 19–20) (Ramos Muñoz et al. 1987, 238; 1989; Durán Balsero 1987). Although no comprehensive anthropological report has been published to date, on the basis of field observations the excavators interpreted that the tomb contained ‘the remains of two individuals inhumed in foetal position’ (Ramos Muñoz et al. 1987, 238–240). The artefacts accompanying these two individuals included a large globular ceramic vessel with a narrow mouth, a copper dagger with four rivets, a copper punch and a micro-flake in black flint (fig. 21) (Ramos Muñoz et al. 1987, 238–240). In the absence of radiocarbon dates, the excavators dated the tomb to the Early Bronze Age based on the morphology and style of these objects (Ramos Muñoz et al. 1987, 240).

A rescue excavation undertaken in 1995 at the site of Rodahuevos, located between the municipalities of Campillos and Antequera, uncovered seven cist burials, of which five were excavated (Fernández Rodríguez et al. 1999). The only published report of this excavation provides a perfunctory description of the architecture and finds, which will be summarised here. Cist #1 presented an accumulation of human bones and grave goods on one of the ends of the cist, while the other end was occupied by a single individual in foetal position. The material culture found in this burial included various pendants made in bone, several perforated beads in limestone and two ornaments made in twisted metal bands, one in copper and another in silver. Cist #2 revealed human remains of up to five individuals. Four of them appeared as commingled bones placed on one of the sides, while the fifth, which appears to be the last internment, was found occupying the opposite half of the chamber, in foetal position.



Fig. 22. Rodahuevos. Cist 3: cairn (photo by Luis Efrén Fernández Rodríguez).



Fig. 23. Rodahuevos. Cist 3: chamber (photo by Luis Efrén Fernández Rodríguez).

The grave goods retrieved from this cist included a number of pottery fragments and a silver spiral band. Cist #3 was covered by a very substantial cairn of pebbles and sealed by a rectangular slab 1.5m in length and 1m in breadth (fig. 22–23).



Fig. 24. Rodahuevos. Cista 4: cairn (photo by Luis Efrén Fernández Rodríguez).



Fig. 25. Rodahuevos. Cista 4: chamber (photo by Luis Efrén Fernández Rodríguez).



Fig. 26. Rodahuevos. Cista 4: chamber (photo by Luis Efrén Fernández Rodríguez).



Fig. 27. Rodahuevos. Cista 4: human remains (photo by Luis Efrén Fernández Rodríguez).

Three individuals were found inside, but the published report does not mention any grave goods. Cists #4 (fig. 24–27) and #5 were not described individually, but jointly. Both are referred to as having a sub-trapezoidal plan and relatively large dimensions, which gave them ‘an archaic appearance, akin to megalithic constructions’ (Fernández Rodríguez et al. 1999, 388). In both cases, human bones were found in a commingled state, with partially articulating anatomical parts. Only one polished ceramic pot was listed in terms of material culture for these two tombs.

Another rescue excavation, undertaken in 2011 as part of the construction of the Antequera-Málaga high-speed railway line, led to the discovery of two burial structures at the site of Torre del Cuchillo (Fernández Rodríguez et al. 2013). Tomb I, almost completely destroyed at the time of excavation, is an orthostatic structure, probably a megalithic cist, with remains of secondary inhumations of three different individuals and some pottery fragments (Fernández Rodríguez et al. 2013, 263–268). Tomb II, located 130m to the west of Tomb I, is a circular-plan pit containing bone remains of four individuals. One of those individuals, the last one to be inhumed, was in a partially articulated position, whereas the bones of the other three were clustered in ‘packages’ arranged around the first (Fernández Rodríguez et al. 2013, 268–271). Two radiocarbon determinations recently obtained as part of the University of Sevilla’s MEGA Project place these inhumations in the Bronze Age (table 2). A date on skull #3 of Tomb I (Beta-526360) gave an age of 1612–1451 BCE (2 σ) whereas another date on a tooth from Tomb II (Beta-526361) provided a result of 1501–1323 BCE (2 σ).

Apart from Alcaide, Las Aguilillas, El Tardón, Morenito I, Rodahuevos and Torre del Cuchillo, two other sites have provided possible evidence of Bronze Age burial practices: the Viera dolmen and the cave of Ardales. In Viera, one radiocarbon date (Beta-353822) obtained from a sample of deer antler (*cervus elaphus*) yielded an Early Bronze Age age: 3580 \pm 30 BP (2020–1880 BCE 2 σ), (Aranda Jiménez et al. 2013). Although there is no unequivocal evidence of Viera being used as a burial ground in the Bronze Age (for example through radiocarbon-dated human remains), it is quite possible that this deer antler was deposited as a

grave good or offering during that period because the dolmen was known and frequented – just like it was the case with the hypogea of Alcaide (and possibly those of Las Aguilillas). Further evidence of the likely use of Viera in the Bronze Age comes from the stratigraphy and materials uncovered during the excavation undertaken in 2003 in support for its restoration. Stratigraphic unit #6 of that excavation, lying directly on top of the bedrock and under a thick layer dating to Antiquity (when the dolmen was also reused as a burial ground), yielded various fragments of pottery that the excavators described as evidence of Late Bronze Age frequentation (Fernández Rodríguez et al. 2006, 97; Fernández Rodríguez 2009, 72). These materials have not been subject to a thorough post-excavation analysis yet, but the preliminary assessment of their age is consistent with the radiocarbon date mentioned above. Examples of reuse of megalithic monuments of Late Neolithic or Copper Age date in the Bronze Age of southern Iberia are abundant (see discussion below).

In the Ardales cave, four radiocarbon dates obtained on unspecified samples of animal bone recovered from the sedimentation cone accumulated at the entrance of the cavity suggest activity in the Early Bronze Age (Rethemeyer 2014, 83). These dates do not prove *per se* that the cave was used for burial practices in the Bronze Age, although the significant amount of human remains and material culture found in its upper galleries, currently under study, strongly suggest intense funerary activity throughout the Late Prehistory.

In addition to all the sites mentioned above, there are imprecise references to Bronze Age cist burials at other locations of the Lands of Antequera (table 4). Most of them were discovered by chance or by looters and their exact location is unknown or they are nowadays destroyed. At Cerro Alcolea (Periana) 15 cists were reported to which two copper daggers, a copper arrowhead and a fragment of a carinated ceramic vessel are attributed (Baldomero Navarro/Ferrer Palma 1984); Cortijo de Gonzalo (Colmenar) is reported for the discovery of five cists from which a riveted dagger and two small chisels were recovered (Baldomero Navarro/Ferrer Palma 1984); near the Iznájar water dam (Cuevas de San Marcos) two cists are reported to have yielded a silver rolled band and two

Site	Number of Cists	Municipality	Ground Plan	Dimensions	Grave Goods	Bibliographic References	Observations
Castillón	NA	Campillos	NA	NA	NA	Ramos Muñoz et al. 1990	
Cementerio Alto	NA	Valle de Abdalajís	NA	NA	NA	Martin Ruiz et al. 1999	
Cerro Alcolea	15	Periana	Presumed rectangular	1.5/1 x 0.5/0.5m	Two metal daggers, one foliaceous metal point and fragments of a carinated vessel	Baldomero Navarro/Ferrer Palma 1984	Mostly destroyed; some materials discovered after sieving
Cortijo de Gonzalo	5	Colmenar	Rectangular	1/0.7 x 0.95/0.6m	One metal dagger and two small metal chisels	Baldomero Navarro/Ferrer Palma 1984	Looted
Embalse de Iznájar	2	Cuevas de San Marcos	NA	NA	One silver spiral bracelet and two metallic points	Marqués Merelo/Aguado Mancha 2012, 39	
Grajeras	1	Ardales	NA	NA	NA	Ramos Muñoz et al. 1990	
La Bolina	1	Ardales	NA	NA	One polished axe, one silex blade and one perforated bead of shell	Ramos Muñoz et al. 1986; 1990	Discovered and destroyed in the 1960s
Lomas del Infierno	NA	Ardales	NA	NA	One riveted sword, one punch and two silver spiral bracelets	Ramos Muñoz et al. 1990; 2004	
Olivar de Jorge	1	Ardales	NA	NA	NA	Ramos Muñoz et al. 1990; 2004	
Playas de Guadalteba y Guadalhorce	NA	Campillos	NA	NA	NA	Marqués Merelo/Aguado Mancha 2012	
Raja del Boquerón	1	Ardales	NA	NA	One riveted sword	Ramos Muñoz et al. 1987; 1990; 2004	Very deteriorated
Tumbalobos	2	Cuevas de San Marcos	NA	NA	One metal punch and one silver ring	Marqués Merelo/Aguado Mancha 2012, 39	

Table 4. Summary description of cist burials dating to the Bronze Age in the Lands of Antequera. NA: Not available.

copper punches (Marqués Merelo/Aguado Mancha 2012, 39). Likewise, at Tumbalobos (Cuevas de San Marcos) another two cists were reportedly found, from which a metal punch and a silver ring were recovered (Marqués Merelo/Aguado Mancha 2012, 39). Other even more vague references locate Bronze Age cists in Castellón (Campillos), Cementerio Alto (Valle de Abdalajís), Grajeras (Ardales), La Bolina (Ardales), Lomas del Infierno (Ardales), Olivar de Jorge (Ardales), Playas de Guadalteba and Guadalhorce (Campillos) and Raja del Boquerón (Ardales) (*table 4*).

3. Discussion

With 181 recorded sites, the occupation of the Lands of Antequera during the Bronze Age entails an average density of 0.06 sites per km², basically half that of the Copper Age (García Sanjuán et al. 2016). A total of 22 radiocarbon dates are currently available for the study of this period of time (*table 2*), of which three were obtained from domestic contexts (La Capellanía, Yacimiento 129 and El Toro) and 14 from burial contexts (Alcaide, El Tardón, Torre del Cuchillo and Viera). As mentioned above, the three dates from Ardales cave (Rethemeyer 2014, 83) date activity in a general sense but there is no certainty that they are connected with Bronze Age burial activity potentially taking place in the upper galleries of the cave.

In general, the availability of radiocarbon dates is quite insufficient to analyse the social and cultural process occurred within a period of approximately 1400 years. It is even difficult to structure the available record within a simple two-phase organisation of Early Bronze Age (ca. 2200–1550 BCE) and Late Bronze Age (ca. 1550–850 BCE). Another problem is that in all cases, excavated settlements (Aratispi, La Capellanía, El Castillejo, Los Castillejos, Castillo de Antequera and Yacimiento 129) were explored by means of stratigraphic sondages or small-scale excavations not followed by any kind of significant post-excavation study. Therefore, the available evidence consists mostly of small assemblages of artefacts and summary records of architectural remains. Considering these limitations, in this section, a general non-systematic and non-quantitative discussion of the

existing empirical base for the Bronze Age taken as a whole will be made (distinguishing where possible between Early Bronze Age and Late Bronze Age), while looking basically at three problems: settlement patterns and locational strategies, economic resources and burial practices.

From the point of view of settlement patterns and locational strategies it is interesting that in three of the excavated settlements, namely Aratispi, La Capellanía and El Castillejo, there is evidence of a strong discontinuity between the Copper Age and Bronze Age. While they were occupied throughout the 3rd mill. BCE, they seem to have experienced a substantial discontinuity during the final centuries of the 3rd and first half of the 2nd mill. BCE, to then be reoccupied in the Late Bronze Age. In addition to this, the remaining four excavated sites (Los Castillejos, Castillo de Antequera, Yacimiento 129 and El Toro) were only inhabited during the Late Bronze Age. Therefore, the empirical record for the Early Bronze Age occupation in the region consists only of the burial deposits radiocarbon-dated at Alcaide, Viera and El Tardón, and presumed on the basis of material culture at Las Aguilillas, Morenito I and Rodahuevos. One important point to bear in mind is that these early 2nd mill. BCE burial sites are characterised by architectures (hypogea, megalithic cists, reuse of a dolmen) and material culture (marine shell ornaments, lithic tools) that convey a strong sense of cultural and ideological continuity with the Late Neolithic and Chalcolithic past. As discussed below, this appearance of underlying continuity in the Early Bronze Age is apparently broken only by the presence of personal ornaments made in silver, including the remarkable Alcaide diadem. Although no information is available as to the individual who wore this diadem, it is worth noting that all Argaric diadems were associated to women.

In light of this, one possibility is that in the last quarter of the 3rd mill. BCE, the Lands of Antequera region experienced a major demographic, social and cultural shift, in line with what has been noted for other Iberian regions, particularly in the southwest (see discussion in Soares/Tavares da Silva 1998; Valera 2015) possibly in connection with the so-called 4.2 ky BP climatic event (Blanco-González et al. 2018; Hinz et al. 2019), as has been

also observed in other regions of Europe and the Mediterranean (Billie/McAneney 2015; Carolin et al. 2018; Malone et al. 2018). Clearly, the settlement dynamics of the Lands of Antequera at the end of the 3rd mill. BCE seem to be less in line with those of the Argaric southeast, characterised by hill-top villages endowed with substantial civil infrastructures (perimeter walls, terraces, large cisterns, public buildings) than with those of the southwest, where settlements for that period are often difficult to pinpoint. The emphasis in burial architectures inspired in the 4th and 3rd mill. BCE and the reuse of monuments from that period also aligns the Lands of Antequera with the cultural dynamics of the southwest rather than with those of the southeast, although there is growing evidence of the reuse of old megalithic monuments in the Argaric Bronze Age too (Aranda Jiménez et al. 2015).

The second half of the 2nd mill. BCE, and particularly its last third, witnessed what appears to be more intense settlement dynamics. This is suggested by several pieces of evidence, including: 1) the reoccupation of Aratispi, El Castillejo and La Capellanía, in the latter case with an inhabited area that substantially exceeded that of the Copper Age and was enclosed by a defensive wall; 2) the activity detected at Los Castillejos, Castillo de Antequera, Yacimiento 129 and Huerta de Peñarrubias, as well as several sites at the confluence of the Guadalhorce and Turón rivers; 3) by the remarkable finds of Almargen, including the ‘Huelva’ type sword and the ‘warrior’ stela, the only of its kind ever found in the Mediterranean hydrological domain of Iberia. The study of the Almargen finds suggests that this site acquired a prominent territorial role as a node of communication between the Málaga coast and the Lands of Antequera on one hand, and the Lower Guadalquivir valley and Huelva region on the other.

Since none of the known settlements has been excavated extensively, there is very little information in terms of their intrinsic characteristics and internal organisation. At La Capellanía, Yacimiento 129 and Huerta de Peñarrubia small walls were found which may represent the foundations or lower bodies of residential architectures, while at La Capellanía floors paved with hardened earth and small pebbles were also identified.

La Capellanía is also the only settlement to have yielded evidence of economic production, a smelting furnace.

In his study of Late Bronze Age settlement patterns, partly based on the excavations at La Capellanía, Martín Córdoba (1994, 9) distinguished four main categories of sites on the basis of their internal organisation and locational characterisation: (i) large settlements located on prominent hills commanding a good visual control of the surroundings, and protected by perimetral stone walls; (ii) secondary settlements of variable size located on hilltops or high ground, and sometimes surrounded by stone walls; (iii) small-size settlements located on hilltops, with a good visual control of the surrounding ground and often near important pathways or mountain passes, sometimes presenting stone walls and other defensive devices (bastions); and (iv) small-size settlements located on low ground of minor elevations, without stone walls, presenting evidence of a strong agricultural economy. La Capellanía represents the first category as a large, topographically dominant and walled settlement. Aratispi, El Castillejo, Los Castillejos and Castillo de Antequera all of smaller size than La Capellanía, but located on topographically commanding locations, can be placed in the second category, while Yacimiento 129 is a good example of a low-ground settlement located on good agricultural land, and perhaps occupied only seasonally.

Altogether, although no formalised spatial analysis has been undertaken, the available evidence suggests that in the Late Bronze Age the communities living in the Lands of Antequera experienced a resurgence, including a process of increased hierarchisation between settlements, more rigid territorialisation and intensified inter-regional connectivity, possibly within the context of growing competition for certain strategic resources, particularly metals. At least three pieces of supporting evidence can be found. Firstly, the presence in Almargen, right on the westernmost part of the Lands of Antequera, of two typically Atlantic cultural markers, a ‘warrior’ stela and a ‘Huelva’ type sword, precisely at the watershed between the Atlantic and the Mediterranean, a sector where the Corbones river acts as a natural corridor connecting Antequera and the lower

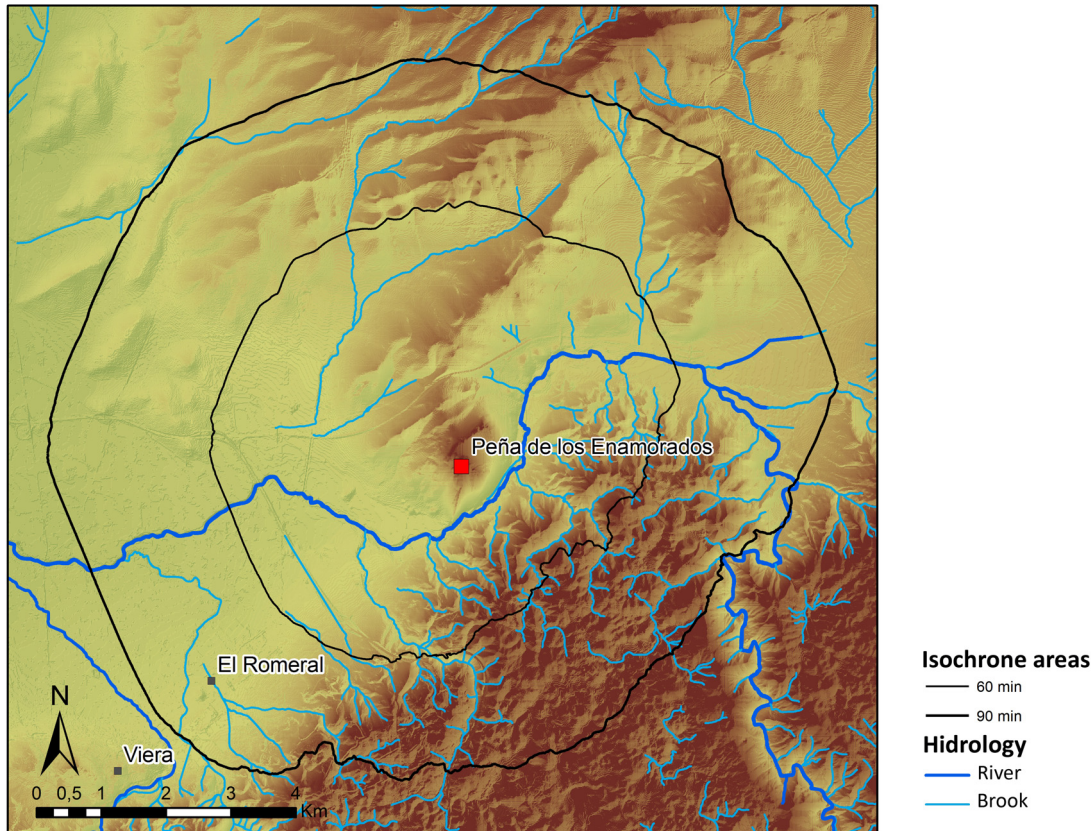


Fig. 28. La Peña de los Enamorados. Isochrone areas (design: Joaquín Márquez Pérez).

Guadalquivir valley (Martín Córdoba 1994, 10; Díaz-Guardamino Uribe et al. 2020). The fact that nowhere else in Mediterranean Iberia a ‘warrior’ stela has been found bears testimony to the geostrategic significance Almarzen must have had in the Late Bronze Age and Early Iron Age. Located on a markedly liminal ground, the military symbology of the stela (coupled with the sword, probably resulting from an aquatic offering) underlines the importance of increased territoriality and boundary-marking in the centuries prior to the start of the Phoenician colonisation along the neighbouring Málaga coast. Secondly, the location of various settlements reveals the importance on control over communication routes and pathways. That is the case with La Peña de Ardales and El Cerrajón (neither of them excavated, but documented through surface finds) both in the municipality of Ardales, which command access towards the Málaga coast along the Guadalteba and Turón rivers, or El Castillón (Campillos), located at the confluence between the Guadalhorce and Guadalteba rivers (Martín Córdoba 1994, 15).

Thirdly, the locational strategy followed in the Late Bronze Age gave clear preference to inaccessible, well-defended hilltops, which causes the isochrone areas of the settlements of this period (fig. 28–31) to be significantly smaller than those of the Copper Age (García Sanjuán et al. 2016). Together with the presence of a major walled enclosure at La Capellanía (and presumably at several other sites), this points to a pattern of tension and competition between communities.

In summary, compared to the Neolithic and Copper Age, Late Bronze Age communities adopted locational strategies that prioritised the defensive factor, accommodating their villages on grounds of mountainous structural morphology, and therefore some distance away from the best arable lands and main water course, a strategy detected through southern Spain in the second half of the 2nd mill. BCE (García Sanjuán 2011, 214 f.).

The available evidence to discuss the Bronze Age economy is really limited. As mentioned, no archaeobotanical or archaeozoological report has ever been published for any of the excavated

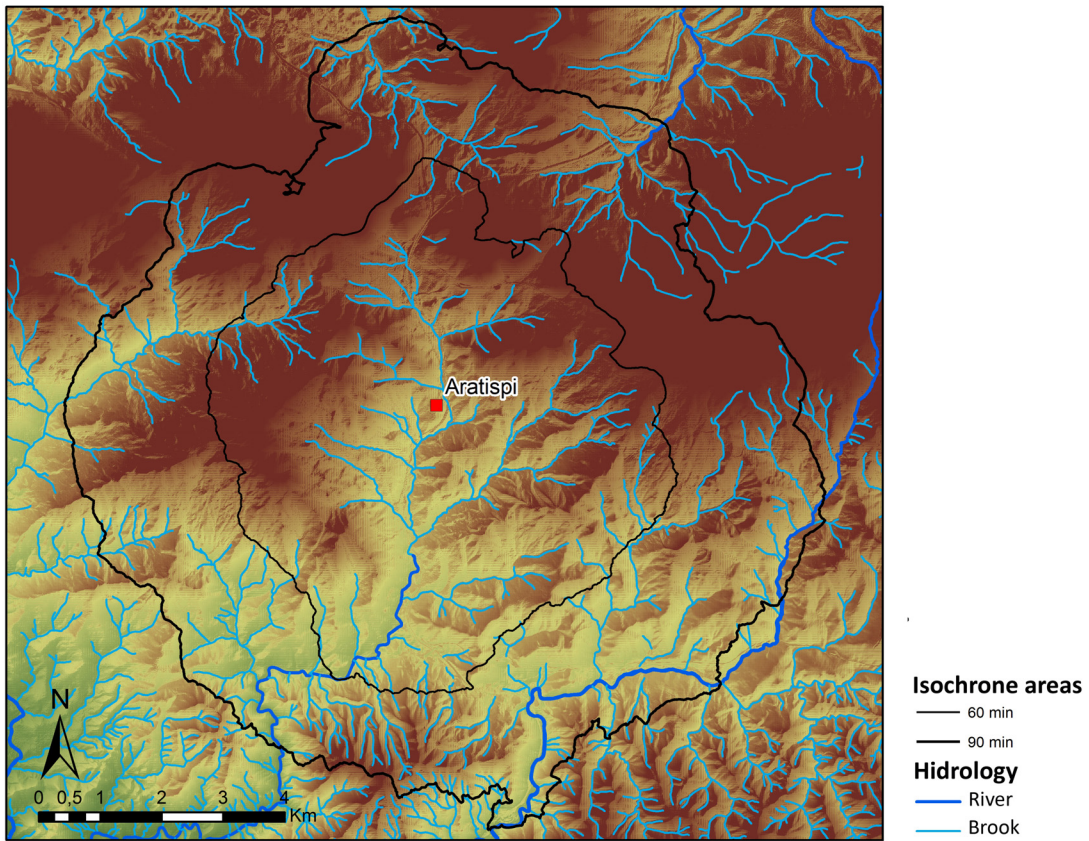


Fig. 29. Aratispi. Isochrone areas (design: Joaquín Márquez Pérez).

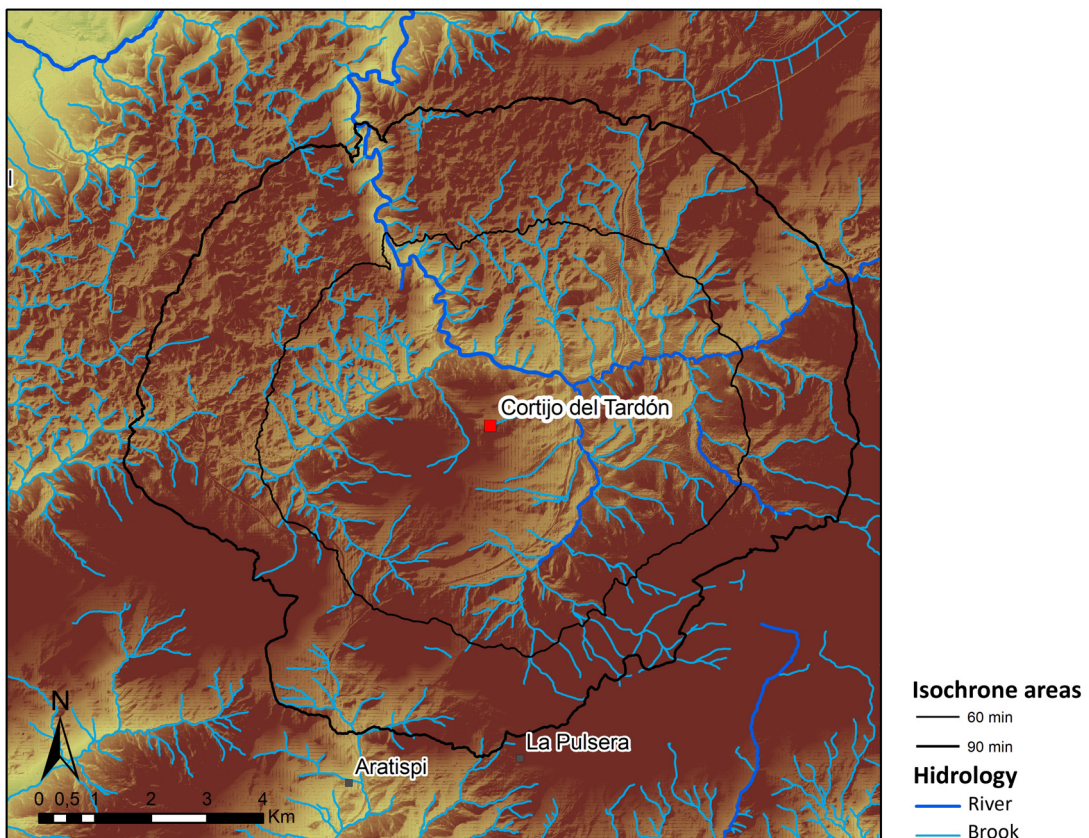


Fig. 30. El Tardón. Isochrone areas (design: Joaquín Márquez Pérez).

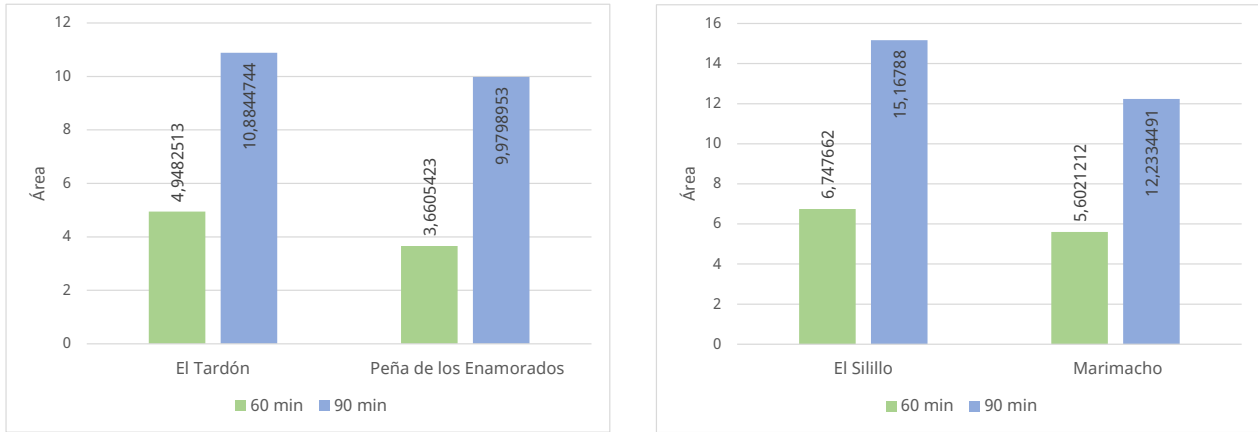


Fig. 31. Comparison of isochrone areas. Left: Bronze Age sites El Tardón and La Peña de los Enamorados. Right: Copper Age sites El Silillo and Marimacho (design: Joaquín Márquez Pérez).

sites. The only site for which any information is available is Las Aguillillas, for which 219 faunal remains are cited, although the data are not presented in a thorough, tabulated format but only through general references made in the text of the published report. The faunal remains identified in this necropolis includes domestic animals such as bovinds, ovicaprids, pigs and dogs as well as wild animals such as deer, rabbit, hare, rodents, fox, various kinds of birds and various types of marine molluscs (*Unio pictorum*, *Cerastoderma edule* and *Pecten maximus*) (Ramos Muñoz et al. 1995, 161). Personal ornaments made of shells from marine molluscs were also found inside El Tardón graves, including *Pecten maximus*. Aside from revealing regular interaction with the coast, the use of scallop shells (*Pecten maximus*) and other marine bivalves as grave goods in Bronze Age burials is significant as a cultural trait, as these objects link up with a long-standing Neolithic and Copper Age tradition.

There is an analogous dearth of evidence concerning the exploitation, transformation and circulation of abiotic resources in the Bronze Age in the Lands of Antequera, with the only exception of copper and silver metallurgy (for a discussion see Rodríguez Vinceiro et al. 1992; 2018; Aranda Jiménez et al. 2021). The inventory of metal objects recorded in the sites described above amounts to 40 objects, including 32 copper-base items (a sword, seven daggers, six points, nine punches, two chisels, a sickle, three spirals and two small plaques) and eight silver-base ones

(one diadem, six spirals and a ring) (table 5).⁴ The only site for which *in situ* evidence of copper smelting has been found is La Capellanía, where a combustion structure for smelting was identified in connection with an arrowhead, a fragment of a smelting pot and a large amount of slag. From the point of view of mining and circulation of metals, isotopic data for the Málaga province are still inconclusive as to the specific role of copper metallurgy in the Lands of Antequera (Rodríguez Vinceiro et al. 2018, 112).

Although when compared with Copper Age (13 items) the collection of Bronze Age metal objects (40 items) represents a threefold increase, in comparison with the collections known for the Iberian southeast, or indeed for other European regions, it represents a very small metallurgical production. The differences between the metallurgies of both periods seem to be more qualitative than quantitative and are reflected in the nature of the manufactured objects and in the appearance of silver metallurgy.

In the Copper Age, copper was mostly applied to the manufacture of tools (punches, chisels, saws, sickles, axes, etc.) whereas in the Bronze Age, while still used to produce tools, it was also

⁴ An assemblage of copper objects not recovered through archaeological work (including two daggers, a punch and more than a dozen fragments of other metallic items as well as a crucible) is attributed to La Peña de los Enamorados (Rodríguez Vinceiro et al. 1992, 227). Since the context and chronology of these objects are not known they have not been included in our inventory.

Site	Evidence	Phase	Bibliographic References
La Capellanía	A combustion structure for smelting in connection with an arrowhead, a fragment of a smelting pot and abundant slag	LBA	Martín Córdoba 1994
El Castillejo	One copper arrowhead	LBA	Fernández Rodríguez/Rodríguez Vinceiro 1995
Cerro Alcolea	Two riveted daggers, one arrowhead	EBA	Baldomero Navarro/Ferrer Palma 1984
Cortijo de Gonzalo	One riveted dagger and two small chisels	EBA	Baldomero Navarro/Ferrer Palma 1984
Alcaide, hypogeum #14	One fragment of a possible chisel made in bronze	LBA	Tovar Fernández et al. 2014
Alcaide, hypogeum #12*	Two arsenical copper daggers	EBA?	Marqués Merelo/Aguado Mancha 2012, 50
Alcaide, hypogeum #9	Silver base: one diadem and three spiral bracelets; Copper base: one punch, two fragments of arrowheads	EBA	Marqués Merelo/Aguado Mancha 2012, 48
El Tardón, Structure A	Two fragments of a punch, probably belonging to the same object, two spiral bracelets and two thin copper foils	EBA	Ferrer Palma et al. 1987; Fernández Ruiz et al. 1997
El Tardón, Structure B	One dagger, one punch, one axe and one Palmela arrowhead	EBA	Ferrer Palma et al. 1987; Fernández Ruiz et al. 1997
Almargen	One 'Huelva-type' sword	LBA	Vilaseca Díaz 1993
Morenito 1	One copper dagger and one copper punch	EBA	Ramos Muñoz et al. 1987; Durán Balsero 1987
Rodahuevos, cist #1	Silver base: one spiral earring Copper base: one spiral earring	EBA	Fernández Rodríguez et al. 1999
Rodahuevos, cist #2	One silver spiral bracelet	EBA	Fernández Rodríguez et al. 1999
Las Aguilillas (Tomb #4)	Two copper punches	EBA	Ramos Muñoz et al. 1995
Embalse de Iznájar	Silver base: one spiral bracelet Copper base: two punches	NA	Marqués Merelo/Aguado Mancha 2012, 39
Tumbalobos	Silver base: one earring Copper base: one punch	NA	Marqués Merelo/Aguado Mancha 2012, 39
Subtotal Copper Base	32 items: one sword, seven daggers, six arrowheads, nine punches, two chisels, one axe, one sickle, three spirals and two foils		
Subtotal Silver Base	eight items: one diadem, six spiral bracelets and one spiral earring		
Total	40 items		

Table 5. Summary of Bronze Age metallurgical evidence at the Lands of Antequera (excluding La Peña de los Enamorados). EBA: Early Bronze Age; LBA: Late Bronze Age; NA: Not available. (*) designated as #7 in Ferrer Palma/Marqués Merelo 1979.

used to make an entirely new series of object types such as swords, halberds and, particularly, personal ornaments (diadems, spiral bracelets, beads, rings, etc.). This is a well-documented phenomenon, which occurred in connection with the new social and ideological role of metal objects (see for example discussions in Montero Ruiz 1994; Costa Caramé/García Sanjuán 2009; Murillo-Barroso/Montero Ruiz 2012).

Of course, a major change in Bronze Age metallurgy was the appearance of silver, of which eight items are known in the Lands of Antequera (22 in the whole of Málaga province), all of them personal ornaments. As mentioned above, the diadem found inside hypogeum #9 at Alcaide, a narrow band that broadens at the centre and without any decoration, is one of only two objects of this kind ever to have been found outside the 'core' area of the Early Bronze Age Argaric culture, in the Vera basin (Almería), where nine of them have been recorded. Diadems have been interpreted as prestige objects reserved for high-ranking individuals, as exemplified in the recently discovered 'princely' tomb of La Almoloya (Lull Santiago et al. 2015).

Among Argaric communities silver objects were used as high-value commodities, as suggested by their presence in high-ranking burials (Aranda Jiménez et al. 2015). More than 700 silver objects, amounting to 2.7kg, have been recorded in Argaric burials to this date (Bartelheim et al. 2012; Murillo-Barroso 2013). By comparison, the eight items recorded in the Lands of Antequera, amounting to only 48g, are a mere shadow of that. The whole of the Málaga province Bronze Age silver amounts to 67.5g (10.5g in cist burials and 57g in megaliths and hypogea) (Aranda Jiménez et al. 2021, 62). One of the bracelets recorded in burial #21 of Cerro de la Encina (Monachil, Granada), with a weight of 39.1g, represents almost as much silver as all the finds made in the Lands of Antequera, while combined, the silver objects retrieved from that tomb largely surpass the amount of all the silver that has ever been recorded in the Bronze Age of the Málaga province (Aranda Jiménez et al. 2021).

The Alcaide diadem is therefore an exceptional find in the Lands of Antequera, and has two

possible implications. Firstly, it seems to be the only clear Early Bronze Age 'borrowing' from the neighbouring Argaric culture in what otherwise is a set of burial practices strongly anchored in the local traditions. Traits that are common in the Argaric burial practices such as 'covachas' (small rock-cut cavities), internments in 'pithoi' (ceramic urns), specific pottery types, or specific metal objects (halberds) are not documented in Antequera. Secondly, as a 'princely' object, the silver diadem conveys the possibility of some degree of 'emulation' on the part of a very restricted segment of the local elites. These two observations lead to the discussion of the burial practices recorded in the region under study.

Basically, the funerary ideology in the Bronze Age of the Lands of Antequera appears to be marked by a significant continuity of Late Neolithic and Copper Age sites (Viera, Alcaide, Las Aguilillas and probably Menga), as well as practices emulating those from the period of 'grandiose' megalithic constructions. In terms of burial architecture, only three of the 14 contexts described above (MNI = 115), namely cists #1, #2 and #3 at Rodahuevos present an 'innovative' morphology, while the remaining eleven repeat archaic patterns well known in the 4th and 3rd mill. BCE such as hypogea, megalithic architecture (megalithic cists) and pit burials (*table 6*). Both radiocarbon dates and the style of the pottery suggest Alcaide hypogea #14 and #15 may have been built in the Early Bronze Age following the already established tradition. Torre del Cuchillo Tomb I, probably a megalithic cist, may also have been built in the Bronze Age, as no evidence of earlier activity was detected. However, the fact that this structure was quite badly damaged and no precise records of its contents could be made, prevents any further consideration as to the chronology of its construction.

From the point of view of the treatment of the bodies, only three tombs (again, cists #1 #2 and #3 at Rodahuevos) are described as individual inhumations, while all others are described as collective ones. The case of Morenito I is difficult to assess because although the excavators describe it as a double inhumation, they did so on the basis

Site/Grave	Architecture	Ritual	MNI	Grave Goods
Alcaide, hypogeum #14	Hypogeum	Collective inhumation	32	Fragments of pottery, knapped lithics, one fragment of a bronze sickle and three personal ornaments
Alcaide, hypogeum #15	Hypogeum	Collective inhumation	15	Some bowls with small applications on the rim, carinated vessels and plates
Alcaide, hypogeum #9	Hypogeum	Collective inhumation	NA	One diadem and three spiral bracelets in silver, one punch, and two arrowhead fragments in copper, one lithic flake and one sickle element; several rim fragments belonging to pottery vessels, including a carinated one
Alcaide, pit B	Pit	Collective inhumation	3	No grave goods
El Tardón, Structure A	Megalithic cist	Collective inhumation	16	One small ceramic pot, one retouched flint blade, one perforated stone pendant and various metallic objects, including two fragments of a punch, two spirals and two thin foil plaques
El Tardón, Structure B	Megalithic cist	Collective inhumation	17	Non-diagnostic undecorated ceramic vessels and some decorated with incisions, one stone wrist-guard, four copper objects, including one dagger, one punch, one axe and one Palmela arrowhead, as well as numerous personal ornaments mostly manufactured on marine shell, including one <i>Pecten maximus</i>
Morenito 1	Megalithic cist	Double inhumation	2	One globular ceramic vessel, one dagger, one copper punch and one small flake in black flint
Las Aguilillas, hypogeum #4	Hypogeum	Collective inhumation	18	One ceramic bowl associated to each skull, numerous stone picks and two copper punches
Rodahuevos, cist #1	Cist	Individual inhumation	1	Personal ornaments, various bone pendants, perforated beads in limestone and two metal spiral earrings, one in copper and one in silver
Rodahuevos, cist #2	Cist	Collective inhumation	5	Various undiagnostic pottery fragments and one silver spiral
Rodahuevos, cist #3	Cist	Collective inhumation	3	NA
Rodahuevos, cist #4	Megalithic cist	Collective inhumation	NA	NA
Rodahuevos, cist #5	Megalithic cist	Collective inhumation	NA	NA
Torre del Cuchillo	Megalithic cist?	Collective inhumation	3	NA

Table 6. Summary data on Bronze Age burial practices in the Lands of Antequera. All descriptions based on published reports. NA: Not available; MNI: Minimum Number of Individuals.

of field observations only, and no full bioanthropological study of that tomb has ever been published. At any rate, the Alcaide and Las Aguilillas hypogea and the El Tardón and Torre del Cuchillo megalithic cists all revealed patterns of collective inhumation in line with those of the Late Neolithic and Copper Age.

The material culture recorded in all these burials reveals a mixture of tradition and innovation but with a strong component of ‘archaism’. The objects that best reveal new relations, ideas, beliefs or fashions are silver ones, and very especially the Alcaide diadem, an artefact clearly formally inspired in Argaric material culture (if not imported from the Argaric area) which may have been used by a local leader to ‘emulate’ the neighbouring Argaric elites. The appearance of this ‘innovative’ object in Bronze Age burials at the Lands of Antequera is quite outweighed by the substantial amounts of ‘traditional’ artefacts found in them, including knapped lithics or, especially, the *Pecten maximus* (scallop) shells found at Las Aguilillas and El Tardón. Scallop shells go back to the 4th mill. BCE as objects endowed with a strong symbolic and ideological significance in the Neolithic worldview and are completely absent in Argaric burials. The scarcity of silver objects and the presence of ‘archaic’ grave goods suggests changing social relationships, but the individualising trends and increased power of the elites present in El Argar appear to have been quite limited, if not altogether absent, in the Lands of Antequera.

In summary, the burial record of the Bronze Age in Antequera is characterized by architectures and material cultures that evoked the ‘powerful past’ of the region in the 4th and 3rd mill. BCE before the crisis that, in the last quarter of the 3rd mill. BCE, seems to have caused the disruption of the old Late Neolithic-Copper Age social system and the abandonment of several settlements. The evolution local communities experienced from approximately 2300 BCE onwards in the Lands of Antequera was quite different from that of south-eastern Spain, and kept them distanced from the Argaric cultural patterns.

4. Conclusions

As discussed above, the empirical record for the study of the Bronze Age in the Antequera region presents severe limitations: lack of a reliable chronometric framework (*table 2* and *fig. 32*), very few excavated settlements, almost complete absence of environmental and economic information and very limited demographic data. Despite these problems, a review of the available evidence suggests a number of interesting (if preliminary) conclusions.

After what appears to be a significant cultural discontinuity at around 2300–2200 BCE (as documented elsewhere in southern Iberia), settlements were located on prominent hilltops that provided good defensive conditions and visual control of the surrounding terrain. This is reflected in the comparatively smaller sizes of isochrone areas and caused major water courses and high-quality arable land to be less readily accessible, a cost that Bronze Age communities seem to have deemed worth assuming in exchange for more safety. By itself, this suggests a more conflictive relationship between communities. The density of sites for the Bronze Age is quite lower than that of the Copper Age (*table 7*), probably suggesting a nucleation of communities in fewer, larger settlements, a phenomenon also observed in other parts of southern Iberia. Generally, this pattern represents a complete inversion of the settlement strategy that had prevailed in the 4th and 3rd mill. BCE, whereby access to good agricultural land and water had been prioritised and naturally implies significant changes in the economic and social organisation (García Sanjuán 2011).

Early Bronze Age settlements are few and very poorly documented, which seems to be connected with the fact that a significant number of Copper Age settlements were abandoned in the last quarter of the 3rd mill. BCE. From a technological and economic point of view, with the available evidence it is only possible to observe the introduction of silver objects and, perhaps, silver metallurgy, but there is no hard evidence that silver metallurgy was undertaken locally. In terms of

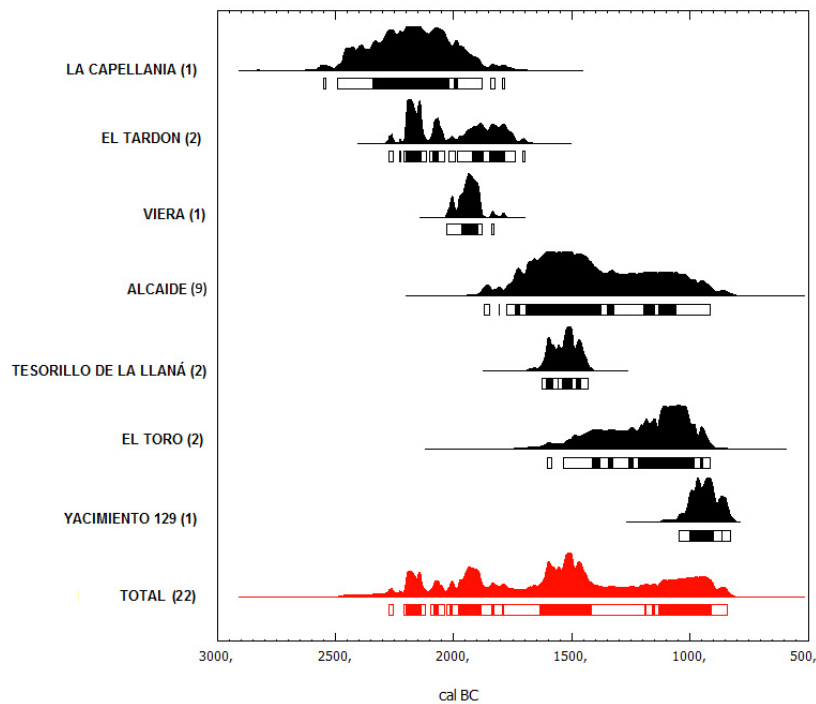


Fig. 32. Summed distributions of radiocarbon dates for the Bronze Age in the Lands of Antequera.

burial practices, there is an intense process of ‘de-monumentalisation’, by which colossal monuments such as Menga, Viera or El Romeral were no longer erected. They did, however, maintain a pervasive ideological presence in the local social life, as suggested by their reuse, or by the construction of ‘megalithic’ cists (a small-scale imitation of ancient megaliths) and large hypogea. An interesting feature of the Early Bronze Age in the Lands of Antequera is the absence of strong signs of ‘argarisation’, despite the relative proximity to the Spanish southeast. Combined, these elements could suggest a deliberate ‘resistance’ to certain social and cultural elements embodied in the Early Bronze Age El Argar culture, such as a stronger breakaway from earlier traditions and a more acute social hierarchisation.

The Late Bronze Age involved a re-occupation of settlements that had been inhabited during the Copper Age and then abandoned, as well as the consolidation of settlement patterns characterised by defensive locational strategies in accordance with a growing phenomenon of territorialisation and competition (rivalries or conflicts?) between communities. The main technological development is the expansion of bronze metallurgy and the expansion of the scales of exchange. The

‘de-monumentalisation’ of burial practices becomes more pronounced, as the only evidence of funerary activity comes from the reuse of artificial caves. All three individuals from the Torre del Cuchillo megalithic cist date to the second half the 2nd mill. BCE, but this tomb was so destroyed at the time of excavation that it is impossible to be certain it was built in that period, too. The only monument that clearly appears to have been erected *ex novo* in this period is the Almargen ‘warrior’ stela, placed on a highly strategic location and probably intended as a territorial marker.

In summary, the Bronze Age in the Lands of Antequera appears to have been visibly marked, perhaps more than anywhere else in southern Iberia, by a phenomenon of cultural continuity pivoting around the pervasive presence of the magnificent megalithic monuments erected in the 4th and 3rd mill. BCE and the social and cultural effects that went with them. Those monuments had created a potent landscape fabric, a true language of the past, whose echoes resonated and reverberated across the 2nd mill. BCE and, as we know today, even further beyond. It is hard not to see the elements of continuity and emulation embodied in the burial architecture described above as an invocation of the powerful legacy

Period	Sites in ARCA	Investigated Sites (Excavated and Surveyed)	Density of Sites per km ²	Density of Sites per Century	Spatio-Temporal Density
Palaeolithic	33	2 (2+0)	0.01	–	–
Neolithic	54	14 (6+8)	0.02	2.34	0.04
Copper Age	290	33 (22+11)	0.11	28.70	3.11
Bronze Age	181	19 (14+5)	0.06	13.33	0.90
Iron Age	211	18 (12+6)	0.07	32.46	2.59
Antiquity	956	NA	0.36	106.22	38.46

Table 7. Data on spatial and temporal density of sites in the Lands of Antequera (2640km²). The estimated duration for all periods involved is as follows: Neolithic (5500–3200 BCE): 23 centuries; Copper Age (3200–2200 BCE): 10 centuries; Bronze Age (2200–850 BCE): 13.5 centuries; Iron Age (850–200 BCE): 6.5 centuries; Antiquity (200 BCE–700 CE): 9 centuries. NA: Not available.

passed down by the Neolithic forebears across the region. As a myriad of documented cases prove (see for example Lorrio Alvarado/Montero Ruiz 2004; García Sanjuán 2005; Bettencourt 2010; Aranda Jiménez 2013; Aranda Jiménez/Lozano Medina 2018; Linares Catela 2020) the maintenance of strong ideological bonds with the past through the reuse of megalithic monuments and hypogea is a marked feature of the Iberian Bronze Age, despite the significant social and cultural changes this period brought about. Perhaps nowhere in Iberia Bronze Age communities had more and better reasons to commemorate the powerful past than in the Lands of Antequera.

If the culture-historical approach to Iberian Late Prehistory was for a long time fixated on the identification of cultural change as a means to establish the temporality (mostly in the form of ‘periodisations’), the Lands of Antequera offer an

excellent laboratory to investigate the form, extent and reach of cultural continuities, not simply as a way to establish the temporality of social life, but as a way to understand the complex balance between present and past, old and new, tradition and innovation, in prehistoric life-ways.

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Bibliography

- Aguado Mancha et al. 1997*: T. Aguado Mancha/A. Baldomero Navarro/J. E. Ferrer Palma/I. Marqués Merelo, Evidencias de hábitat en el yacimiento de Alcaide (Antequera, Málaga). In: Sociedade Portuguesa de Antropologia e Etnologia (ed.), Actas del I Congreso de Arqueología Peninsular (Porto, 12–18 de Outubro de 1993) (Porto 1997) 151–164.
- Aguado Mancha et al. 2002*: T. Aguado Mancha/A. Baldomero Navarro/J. E. Ferrer Palma/I. Marqués Merelo, Evidencias de hábitat en el yacimiento de Alcaide (Antequera, Málaga). *Mainake. Estudios de Arqueología Malagueña* 24, 2002, 335–373.
- Aranda Jiménez 2013*: G. Aranda Jiménez, Against Uniformity Cultural Diversity. The ‘Others’ in Argaric Societies. In: M. Cruz Berrocal/L. García Sanjuán/A. Gilman (eds.), *The Prehistory of Iberia. Debating Early Social Stratification and the State* (New York 2013) 99–118.

- Aranda Jiménez/Lozano Medina 2018*: G. Aranda Jiménez/A. Lozano Medina, Long-Lasting Sacred Landscapes. The Numerical Chronology of the Megalithic Phenomenon in South-Eastern Iberia. *Journal of Archaeological Science. Reports* 19, 2018, 224–238.
- Aranda Jiménez et al. 2013*: G. Aranda Jiménez/L. García Sanjuán/A. Lozano Medina/M. E. Costa Caramé, Nuevas dataciones radiométricas del dolmen de Viera (Antequera, Málaga). *La Colección Gómez-Moreno. Menga. Revista de Prehistoria de Andalucía* 4, 2013, 235–249.
- Aranda Jiménez et al. 2015*: G. Aranda Jiménez/S. Montón-Subías/M. Sánchez Romero, *The Archaeology of Bronze Age Iberia*. Argaric Societies (New York 2015).
- Aranda Jiménez et al. 2021*: G. Aranda Jiménez/L. Milesi García/Á. Lozano Medina, Las prácticas funerarias de la Edad del Bronce en la provincia de Málaga (España). *Spal. Revista de Prehistoria y Arqueología* 30.1, 2021, 46–70.
- Aubet Semmler et al. 1983*: M. E. Aubet Semmler/M. R. Serna/J. L. Escacena Carrasco/M. M. Ruiz Delgado, La Mesa de Setefilla. Lora del Río (Sevilla). Campaña de 1979. *Excavaciones Arqueológicas en España* 122 (Madrid 1983).
- Baldomero Navarro 2001*: A. Baldomero Navarro, Avance al estudio del poblamiento en la bahía de Málaga y su hinterland en los inicios de la metalurgia. *Baetica. Estudios de Arte, Geografía e Historia* 23, 2001, 239–261.
- Baldomero Navarro/Ferrer Palma 1984*: A. Baldomero Navarro/J. E. Ferrer Palma, Las necrópolis en cistas de la provincia de Málaga. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 9, 1984, 195–235.
- Bartelheim et al. 2012*: M. Bartelheim/F. Contreras Cortés/A. Moreno Onorato/M. Murillo-Barroso/E. Pernicka, The Silver of the South Iberian El Argar Culture. A First Look into Production and Distribution. *Trabajos de Prehistoria* 69.2, 2012, 293–309.
- Bettencourt 2010*: A. M. S. Bettencourt, La Edad del Bronce en el Noroeste de la Península Ibérica. Un análisis a partir de las prácticas funerarias. *Trabajos de Prehistoria* 67.1, 2010, 139–173.
- Billie/McAneney 2015*: M. Billie/J. McAneney, Why Should We Not Ignore the Mid-24th Century BC When Discussing the 2200–2000 BC Climate Anomaly? In: H. Meller/H. W. Arz/R. Jung/R. Risch (eds.), *2200 BC. A Climatic Breakdown as a Cause for the Collapse of the Old World*. 7th Archaeological Conference of Central Germany (October 23–26, 2014, Halle, Saale) (Halle 2015) 833–844.
- Blanco-González et al. 2018*: A. Blanco-González/K. Lillios/J. A. López-Sáez/B. L. Drake, Cultural, Demographic and Environmental Dynamics of the Copper and Early Bronze Age in Iberia (3300–1500 BC). Towards an Interregional Multiproxy Comparison at the Time of the 4.2 ky BP Event. *Journal of World Prehistory* 31.1, 2018, 1–79.
- Bradley/García Sanjuán 2017*: R. Bradley/L. García Sanjuán, Sudden Time? Natural Disasters as a Stimulus to Monument Building. From Silbury Hill (Great Britain) to Antequera (Spain). In: P. Bickle/V. Cummings/D. Hofmann/J. Pollard (eds.), *Neolithic Europe. Essays in Honour of Professor Alasdair Whittle* (Oxford 2017) 181–201.
- Carolin et al. 2018*: S. Carolin/R. T. Walker/C. C. Day/V. Ersek/R. Sloan/M. W. Dee/M. Talebian/G. M. Henderson, Precise Timing of Abrupt Increase in Dust Activity in the Middle East Coincident with 4.2 ka Social Change. *Proceedings of the National Academy of Sciences* 116.1, 2018, 67–72.
- Castro Martínez et al. 1999*: P. Castro Martínez/R. W. Chapman/S. Gili/V. Lull Santiago/R. Micó Pérez/C. Rihuete/R. Risch/M. E. Sanahuja, *Proyecto Gatas 2. La Dinámica Arqueoecológica de la Ocupación Prehistórica* (Sevilla 1999).
- Contreras Cortés et al. 2000*: F. Contreras Cortés/M. Sánchez Ruiz/F. Nocete Calvo (eds.), *Proyecto Peñalosa. Análisis histórico de las comunidades de la Edad del Bronce del piedemonte meridional de Sierra Morena y depresión Linares-Bailén*. *Arqueología Monografías* 10 (Sevilla 2000).

- Costa Caramé/García Sanjuán 2009*: M. E. Costa Caramé/L. García Sanjuán, El papel ideológico de las producciones metálicas en la Edad del Bronce. El caso del Suroeste de la Península Ibérica (c. 2200–1500 cal ANE). Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 19, 2009, 195–224.
- De Mergelina 1922*: C. De Mergelina, La necrópolis tartesia de Antequera. Actas y Memorias de la Sociedad Española de Antropología, Etnología y Prehistoria 4, 1922, 37–90.
- Díaz-Guardamino Uribe et al. 2020*: M. Díaz-Guardamino Uribe/L. García Sanjuán/D. Wheatley/J. A. Lozano Rodríguez/M. A. Rogerio-Candelera/M. Casado Ariza, Late Prehistoric Stelae and Persistent Places. A Multi-Disciplinary Review of the Evidence at Almargen (Lands of Antequera, Spain). Cambridge Archaeological Journal 30.1, 2020, 69–96.
- Durán Balsero 1987*: J. J. Durán Balsero, Informe sobre la composición elemental de dos utensilios prehistóricos procedentes del enterramiento de la Edad del Bronce denominado Morenito I, sito en el término municipal de Ardales (Málaga). Anuario Arqueológico de Andalucía 1986.III, 1987, 245–246.
- Espejo Herrerías et al. 1990*: M. M. Espejo Herrerías/C. Martín Domínguez/P. Cantalejo Duarte, Galeota, un taller de sílex calcolítico (Ardales, Málaga). Colección Martín Domínguez. Mainake. Estudios de Arqueología Malagueña 11–12, 1990, 21–40.
- Fernández Rodríguez 2005*: L.-E. Fernández Rodríguez, Un nuevo yacimiento del Bronce Final en las riveras del río Guadalhorce a su paso por la vega de Antequera. El yacimiento número 129 del catálogo del término municipal de Antequera afectado por la traza de la línea AVE Córdoba-Málaga. Tramo X. Anuario Arqueológico de Andalucía 2002.III, 2005, 87–96.
- Fernández Rodríguez 2009*: L.-E. Fernández Rodríguez, La interacción entre los proyectos de restauración de estructuras y la investigación arqueológica. Caso del sepulcro megalítico de la Cueva de Viera. Caetaria 6–7, 2009, 61–74.
- Fernández Rodríguez/Rodríguez Vinceiro 1995*: L.-E. Fernández Rodríguez/F. J. Rodríguez Vinceiro, El sondeo estratigráfico del asentamiento de El Castillejo, Almogía (Málaga). Resultados preliminares del Corte 1. In: Actas del XXIII Congreso Nacional de Arqueología (Elche 1995) 59–72.
- Fernández Rodríguez et al. 1999*: L.-E. Fernández Rodríguez/F. J. Rodríguez Vinceiro/A. Palomo Luburu/J. A. Santamaría García/J. Suárez Padilla/I. Navarro Luengo/A. Arancibia Román/M. M. Escalante/J. M. Ángel, Informe preliminar de la excavación arqueológica de urgencia en la necrópolis de la Edad del Bronce del Cortijo de Rodahuevos (Antequera-Campillos, Málaga). Anuario Arqueológico de Andalucía 1995.III, 1999, 384–390.
- Fernández Rodríguez et al. 2006*: L.-E. Fernández Rodríguez/M. Romero Pérez/R. Ruiz de la Linde, Resultados preliminares del control arqueológico de los trabajos de consolidación del sepulcro megalítico de Viera, Antequera. Anuario Arqueológico de Andalucía 2003.III-2, 2006, 89–99.
- Fernández Rodríguez et al. 2013*: L.-E. Fernández Rodríguez/I. Ruiz Somavilla/M. I. Cisneros García/A. Palomo Laburu/M. Crespo Santiago, Novedades en torno al ritual funerario megalítico. Avance al estudio de la necrópolis megalítica del Cerro de la Torre del Cuchillo. Bobadilla, Antequera. Mainake. Estudios de Arqueología Malagueña 34, 2013, 259–276.
- Fernández Ruiz et al. 1997*: J. Fernández Ruiz/I. Marqués Merelo/J. E. Ferrer Palma/A. Baldomero Navarro, Los enterramientos colectivos de El Tardón (Antequera, Málaga). In: R. De Balbín Behrmann/P. Bueno Ramírez (eds.), Actas del II Congreso de Arqueología Peninsular, II. Neolítico, Calcolítico y Bronce (Zamora, 24–27 de septiembre de 1996) (Zamora 1997) 371–380.
- Ferrer Palma et al. 1987*: J. E. Ferrer Palma/J. Fernández Ruiz/I. Marqués Merelo, Excavaciones en la necrópolis campaniforme de El Tardón (Antequera, Málaga), 1985. Anuario Arqueológico de Andalucía 1985.III, 1987, 240–243.
- García Alfonso 1994*: E. García Alfonso, Los Castillejos de Teba (Málaga). Excavaciones de 1993. Estratigrafía de los siglos VIII–VII a.C. Mainake. Estudios de Arqueología Malagueña 15–16, 1994, 45–84.

- García Alfonso 1996*: E. García Alfonso, Puntas de flecha en anzuelo halladas en Los Castillejos de Teba. Notas sobre estos materiales de los siglos VII–VI a.C. en Málaga. *Jábega* 76, 1996, 16–24.
- García Alfonso 1999*: E. García Alfonso, Huertas de Peñarrubia (Campillos, Málaga). Un asentamiento del Bronce Final-Hierro Antiguo en el valle del Guadalteba. *Anuario Arqueológico de Andalucía* 1994.III, 1999, 362–374.
- García Pérez et al. 2020*: S. García Pérez/V. Hurtado Pérez/L. García Sanjuán/M. Cintas-Peña, Las múltiples formas de lo sagrado. Las imágenes portables del Neolítico Final y la Edad del Cobre en el Sur de España. In: P. Bueno Ramírez/J. Soler Díez (eds.), *Los Ídolos del Neolítico y Calcolítico de la Península Ibérica* (Alicante 2020) 245–264.
- García Sanjuán 1999*: L. García Sanjuán, Los Orígenes de la Estratificación Social. Patrones de Desigualdad en la Edad del Bronce del Suroeste de la Península Ibérica (Sierra Morena Occidental c. 1700–1100 A.N.E./2100–1300 A.N.E.). *British Archaeological Reports, International Series S823* (Oxford 1999).
- García Sanjuán 2005*: L. García Sanjuán, Las piedras de la memoria. La permanencia del megalitismo en el Suroeste de la Península Ibérica durante el II y I milenios ANE. *Trabajos de Prehistoria* 62.1, 2005, 85–109.
- García Sanjuán 2009*: L. García Sanjuán, Criterios para un programa de investigación. Sociedades, territorios y paisajes en la Prehistoria de Antequera. In: B. Ruiz González (ed.), *Dólmenes de Antequera. Tutela y Valorización Hoy* (Sevilla 2009) 112–127.
- García Sanjuán 2011*: L. García Sanjuán, El estatuto epistemológico del análisis territorial en la investigación de la Prehistoria Reciente andaluza. Trayectoria y perspectivas. In: *Actas del Primer Congreso de Prehistoria de Andalucía. La Tutela del Patrimonio Prehistórico. Memorial Luis Siret* (Antequera, 22–25 de septiembre de 2010) (Sevilla 2011) 207–218.
- García Sanjuán/Lozano Rodríguez 2016*: L. García Sanjuán/J. A. Lozano Rodríguez, Menga (Andalusia, Spain). Biography of an Exceptional Megalithic Monument. In: L. Laporte/C. Scarre (eds.), *The Megalithic Architectures of Europe* (Oxford 2016) 3–16.
- García Sanjuán/Mora Molina 2018*: L. García Sanjuán/C. Mora Molina (eds.), *La Intervención de 2005 en el Dolmen de Menga. Temporalidad, Biografía y Cultura Material en un Monumento del Patrimonio Mundial* (Sevilla 2018).
- García Sanjuán/Wheatley 2009*: L. García Sanjuán/D. Wheatley, El marco territorial de los dólmenes de Antequera. Valoración preliminar de las primeras investigaciones. In: B. Ruiz González (ed.), *Dólmenes de Antequera. Tutela y Valorización Hoy* (Sevilla 2009) 128–143.
- García Sanjuán et al. 2010*: L. García Sanjuán/D. W. Wheatley/M. E. Costa Caramé, Prospección de superficie en Antequera, Málaga. Campaña de 2006. *Anuario Arqueológico de Andalucía* 2006 (Sección Málaga), 2010, 3716–3737.
- García Sanjuán et al. 2016*: L. García Sanjuán/M. C. Moreno Escobar/J. Márquez Pérez/D. Wheatley, The Copper Age in the Lands of Antequera (Málaga, Spain). Introduction to the Settlement Patterns and Social Dynamics. *Zephyrus* 78, 2016, 35–65.
- García Sanjuán et al. 2019*: L. García Sanjuán/C. Mora Molina/M. Bartelheim, The Antequera Megalithic Site in the Work of Georg and Vera Leisner. A Review. *Spal. Revista de Prehistoria y Arqueología* 28.2, 2019, 1–46.
- García Sanjuán et al. 2021*: L. García Sanjuán/R. Montero Artús/C. Mora Molina, Waterscapes through Time. The Menga Well as a Unique Hydraulic Resource in its Geographic and Historical Context. In: M. Bartelheim/R. Hardenberg/L. García Sanjuán (eds.), *Human-Made Environments. The Development of Landscapes as Resource Assemblages. RessourcenKulturen* 15 (Tübingen 2021) 89–116.
- Giménez Reyna 1946*: S. Giménez Reyna, *Memoria Arqueológica de la Provincia de Málaga hasta 1946. Informes y Memorias de la Comisaría de Excavaciones Arqueológicas* 12 (Madrid 1946).

- Giménez Reyna 1953*: S. Giménez Reyna, Alcaide (Antequera, Málaga). *Noticiario Arqueológico Hispánico* 1, 1953, 43–55.
- Gómez Moreno Martínez 1905*: M. Gómez Moreno Martínez, Arquitectura Tartesia. La necrópolis de Antequera. *Boletín de la Real Academia de la Historia* 47, 1905, 81–132.
- Hemp 1934*: W. J. Hemp, The Passage Graves of Antequera and Maes Howe, Orkney. *The Antiquaries Journal* 14, 1934, 404–413.
- Hinz et al. 2019*: M. Hinz/J. Schirrmacher/J. Kneisel/C. Rinne/M. Weinelt, The Chalcolithic-Bronze Age Transition in Southern Iberia under the Influence of the 4.2 ka BP Event? A Correlation of Climatological and Demographic Proxies. *Journal of Neolithic Archaeology* 21, 2019, 1–26.
- Leisner/Leisner 1943*: G. Leisner/V. Leisner, Die Megalithgräber der Iberischen Halbinsel. *Der Süden. Römisch-Germanische Forschungen* 1 (Berlin 1943).
- Leiva Riojano/Ruiz González 1977*: A. Leiva Riojano/B. Ruiz González, La cueva de La Pulsera, Antequera, Málaga. In: *Actas del XV Congreso Nacional de Arqueología (Lugo 28 al 30 septiembre 1977)* (Lugo 1977) 545–552.
- Linares Catela 2020*: J. A. Linares Catela, Monumentalidad funeraria del Bronce en el Sur de la Península Ibérica. La necrópolis de La Orden-El Seminario (Huelva). *Spal. Revista de Prehistoria y Arqueología* 29.1, 2020, 13–39.
- Lorrio Alvarado/Montero Ruiz 2004*: A. J. Lorrio Alvarado/I. Montero Ruiz, Reutilización de sepulcros colectivos en el Sureste de la Península Ibérica: la colección Siret. *Trabajos de Prehistoria* 61.1, 2004, 99–116.
- Lull Santiago 1983*: V. Lull Santiago, La Cultura de El Argar. Un Modelo para el Estudio de las Formaciones Económico-Sociales Prehistórica (Madrid 1983).
- Lull Santiago et al. 2015*: V. Lull Santiago/R. Micó Pérez/C. Rihuete Herrada/R. Risch/E. Celdrán Beltrán/M. I. Fregeiro Morador/C. Oliart Caravatti/C. Velasco Felipe, La Almoloya (Pliego, Murcia). *Ruta Argárica. Guías Arqueológicas* 2 (Murcia 2015).
- Macías López 1995*: M. Macías López, Paleodemografía y paleopatología de los restos humanos de la necrópolis de Las Aguilillas (Ardales, Málaga). In: P. Cantalejo Duarte/J. J. Durán Valsero/M. M. Espejo Herreras (eds.), *Geología y Arqueología Prehistórica de Ardales* (Ardales 1995) 167–174.
- Malone et al. 2018*: C. Malone/N. Cutajar/T. Rowan McLaughlin/B. Mercieca-Spiteri/A. Pace/R. K. Power/S. Stoddart/S. Sultana/C. Bronk Ramsey/E. Dunbar/A. Bayliss/F. Healy/A. Whittle, Island Questions. The Chronology of the Brochtorff Circle at Xagħra, Gozo, and its Significance for the Neolithic Sequence on Malta. *Archaeological and Anthropological Sciences* 11, 2018, 4251–4306.
- Marqués Merelo 1983*: I. Marqués Merelo, Sepulcro inédito de la necrópolis de Alcaide (Antequera, Málaga). *Cuadernos de Prehistoria de la Universidad de Granada* 8, 1983, 149–173.
- Marqués Merelo 1987*: I. Marqués Merelo, La necrópolis de Alcaide (Antequera, Málaga). Campaña de excavaciones. *Anuario Arqueológico de Andalucía* 1986.II, 1987, 330–332.
- Marqués Merelo 1992*: I. Marqués Merelo, El yacimiento de Alcaide (Antequera-Málaga). Campaña de excavaciones de 1987. *Anuario Arqueológico de Andalucía* 1990.II, 1992, 268–270.
- Marqués Merelo/Aguado Mancha 2012*: I. Marqués Merelo/T. Aguado Mancha, Los Enterramientos de la Edad del Bronce en la Provincia de Málaga. *Studia Malacitana* 43 (Málaga 2012).
- Marqués Merelo/Ferrer Palma 1979*: I. Marqués Merelo/J. E. Ferrer Palma, Las campañas de excavaciones arqueológicas en la necrópolis de Alcaide (Antequera, Málaga). *Mainake. Estudios de Arqueología Malagueña* 1, 1979, 61–84.

- Marqués Merelo/Ferrer Palma 1983*: I. Marqués Merelo/J. E. Ferrer Palma, Aportaciones al primer horizonte cronológico de Alcaide (Antequera, Málaga). In: Actas del XVI Congreso Nacional de Arqueología, Cartagena (Murcia) 1982 (Zaragoza 1983) 227–238.
- Marqués Merelo et al. 1992*: I. Marqués Merelo/J. E. Ferrer Palma/J. E. Márquez Romero, Actuaciones en el yacimiento de Alcaide (Antequera, Málaga) durante la campaña de 1990. Anuario Arqueológico de Andalucía 1990.II, 1992, 210–212.
- Márquez Romero/Marqués Merelo 1997*: J. E. Márquez Romero/I. Marqués Merelo, La fuente de suministro lítico del yacimiento de Alcaide (Antequera-Málaga). Baetica. Estudios de Arte, Geografía e Historia 19.1, 1997, 371–394.
- Martín Córdoba 1994*: E. Martín Córdoba, Aportación de la documentación arqueológica del Cerro de La Capellanía (Periana, Málaga) a los inicios del primer milenio a.C. en la provincia de Málaga. Mainake. Estudios de Arqueología Malagueña 15–16, 1994, 5–36.
- Martín Córdoba/Recio Ruiz 2004*: E. Martín Córdoba/A. Recio Ruiz, Aportación de la documentación arqueológica del Cerro de Capellanía (Periana, Málaga) al desarrollo de las comunidades calcolíticas de las tierras orientales de Málaga. Actas de los Simposios de Prehistoria de la Cueva de Nerja. La Problemática del Neolítico en Andalucía. Las Primeras Sociedades Metalúrgicas en Andalucía (Nerja 2004) 341–351.
- Martín Córdoba et al. 1992*: E. Martín Córdoba/A. Recio Ruiz/J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte, Avance al poblamiento del Bronce Final en la cuenca del río Turón y su intersección con el Guadalhorce (Ardales, Málaga). Mainake. Estudios de Arqueología Malagueña 13–14, 1992, 51–78.
- Martín Ruiz et al. 1999*: J. A. Martín Ruiz/J. M. Martín Ruiz/P. J. Sánchez Bandera, Prospección arqueológica en el término municipal de El Valle de Abdalajís. Anuario Arqueológico de Andalucía 1994.II, 1999, 154–160.
- Martín Socas et al. 2004*: D. Martín Socas/M. D. Camalich Massieu/P. González Quintero (eds.), La Cueva del Toro (Sierra del Torcal, Antequera, Málaga). Un Modelo de Ocupación Ganadera en el Territorio Andaluz entre el VI y II Milenios ANE (Sevilla 2004).
- Mitjana y Ardison 1847*: R. Mitjana y Ardison, Memoria sobre el templo druida hallado en las cercanías de la ciudad de Antequera (Málaga 1847).
- Mora Molina 2019*: C. Mora Molina, Los Monumentos Megalíticos de Antequera (Málaga). Una Aproximación Biográfica (PhD-Thesis University of Sevilla 2019).
- Moreno Aragüez/Ramos Muñoz 1983*: A. Moreno Aragüez/J. Ramos Muñoz, Peña de los Enamorados. Un yacimiento de la Edad del Bronce en la Depresión de Antequera. Mainake. Estudios de Arqueología Malagueña 4–5, 1983, 53–74.
- Moreno Escobar/García Sanjuán 2013*: M. C. Moreno Escobar/L. García Sanjuán, Sistematización e informatización del inventario de yacimientos arqueológicos de Tierras de Antequera. La base de datos ARCA. Menga. Revista de Prehistoria de Andalucía 4, 2013, 217–233.
- Montero Ruiz 1994*: I. Montero Ruiz, El Origen de la Metalurgia en el Sudeste de la Península Ibérica. Colección Investigación 19 (Almería 1994).
- Murillo-Barroso 2013*: M. Murillo-Barroso, Producción y Consumo de Plata en la Península Ibérica. Un Análisis Comparativo entre la Sociedad Argárica y los Primeros Asentamientos Orientalizantes (PhD-Thesis University of Granada 2013).
- Murillo-Barroso/Montero Ruiz 2012*: M. Murillo-Barroso/I. Montero Ruiz, Copper Ornaments in the Iberian Chalcolithic. Technology versus Social Demand. Journal of Mediterranean Archaeology 25.1, 2012, 53–73.

- Perdiguero López 1989*: M. Perdiguero López, Aratispi (Cauche el Viejo, Antequera). Investigaciones Arqueológicas 65 (Málaga 1989).
- Perdiguero López 1990*: M. Perdiguero López, Asentamiento calcolítico en Aratispi (Cauche el Viejo, Antequera). Mainake. Estudios de Arqueología Malagueña 11–12, 1990, 57–80.
- Perdiguero López 1992*: M. Perdiguero López, Fase del Bronce Final en Aratispi (Cauche el Viejo, Antequera). Mainake. Estudios de Arqueología Malagueña 13–14, 1992, 29–50.
- Perdiguero López 1994*: M. Perdiguero López, La fase ibérica en Aratispi (Cauche el Viejo, Antequera). Mainake. Estudios de Arqueología Malagueña 15–16, 1994, 115–166.
- Perdiguero López 1998*: M. Perdiguero López, Aratispi. La facies protohistórica y su evolución en el tiempo. Villanueva de Cauche (Antequera). Mainake. Estudios de Arqueología Malagueña 19–20, 1998, 47–70.
- Ramos Muñoz et al. 1986*: J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte, Taller Calcolítico del Castillo del Turón (Ardales, Málaga) (Ardales 1986).
- Ramos Muñoz et al. 1987*: J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte/F. Ramírez Trillo, Excavación arqueológica de urgencia en una cista de la Edad del Bronce. Morenito I (Ardales, Málaga). Anuario Arqueológico de Andalucía 1986.III, 1987, 236–245.
- Ramos Muñoz et al. 1989*: J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte, Morenito 1. Un enterramiento de la Edad del Bronce (Ardales, Málaga). In: Actas del XIX Congreso Nacional de Arqueología (Castellón de la Plana 1987) (Zaragoza 1989) 409–421.
- Ramos Muñoz et al. 1990*: J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte/E. Martín Córdoba, Informe sobre las prospecciones arqueológicas superficiales realizadas en el Valle del Turón, término municipal de Ardales (Málaga). Anuario Arqueológico de Andalucía 1987.II, 1990, 66–72.
- Ramos Muñoz et al. 1995*: J. Ramos Muñoz/A. Recio Ruiz/P. Cantalejo Duarte/E. Martín Córdoba/V. Castañeda Fernández/M. Pérez Rodríguez, La necrópolis colectiva de cuevas artificiales del II milenio ANE del Cerro de Las Aguilillas (Ardales-Campillos, Málaga). In: P. Cantalejo Duarte/J. J. Durán Valsero/M. M. Espejo Herrerías (eds.), Geología y Arqueología Prehistórica de Ardales (Ardales 1995) 149–166.
- Ramos Muñoz et al. 1997*: J. Ramos Muñoz/M. M. Espejo Herrerías/A. Recio Ruiz/P. Cantalejo Duarte/E. Martín Córdoba/J. Durán Valsero/V. Castañeda Fernández/M. Pérez Rodríguez, La necrópolis colectiva del Cerro de Las Aguilillas (Ardales-Campillos, Málaga). Inferencias socioeconómicas. Revista Atlántica-Mediterránea de Prehistoria y Arqueología Social 1, 1997, 19–180.
- Ramos Muñoz et al. 1999*: J. Ramos Muñoz/A. Recio Ruiz/P. Cantalejo Duarte/E. Martín Córdoba/V. Castañeda Fernández/M. Pérez Rodríguez, Excavación arqueológica de urgencia en la necrópolis colectiva de cuevas artificiales del cerro de Las Aguilillas (Ardales/Campillos, Málaga). Informe preliminar. Anuario Arqueológico de Andalucía 1994.III, 1999, 355–361.
- Ramos Muñoz et al. 2004*: J. Ramos Muñoz/M. M. Espejo Herrerías/P. Cantalejo Duarte, La formación económico social clasista inicial (milenio III y II a.n.e.) en los entornos de Ardales (Málaga). In: Actas del III Simposio de Prehistoria Cueva de Nerja. Las primeras sociedades metalúrgicas de Andalucía. Homenaje a Antonio Arribas Palau (Málaga 2004) 309–320.
- Rethemeyer 2014*: J. Rethemeyer, Dataciones C14. In: J. Ramos Muñoz/G. C. Weniger/P. Cantalejo Duarte/M. M. Espejo Herrerías (eds.), Cueva de Ardales 2011–2014. Intervenciones Arqueológicas (Ardales 2014) 83–84.
- Rodríguez Vinceiro/Márquez Romero 2003*: F. J. Rodríguez Vinceiro/J. E. Márquez Romero, Dataciones absolutas para la Prehistoria Reciente de la provincia de Málaga. Una revisión crítica. Baetica. Estudios de Arte, Geografía e Historia 25, 2003, 313–354.

- Rodríguez Vinceiro et al. 1992*: F. J. Rodríguez Vinceiro/L.-E. Fernández Rodríguez/J. L. Clavero Toledo/C. Romero Silva/C. von Thode Mayoral/A. García Pérez/J. Suárez Padilla/M. Barrera/A. Palomo Laburu, Estado actual de la investigación arqueometalúrgica prehistórica en la provincia de Málaga. *Trabajos de Prehistoria* 49, 1992, 217–242.
- Rodríguez Vinceiro et al. 2018*: F. Rodríguez Vinceiro/M. Murillo-Barroso/L.-E. Fernández Rodríguez /I. Montero Ruiz, Metalurgia prehistórica en Tierras de Antequera y su contexto andaluz. *Zephyrus* 81, 2018, 93–115.
- Rogério-Candelera et al. 2018*: M. A. Rogério-Candelera/P. Bueno Ramírez/R. De Balbín Behrmann/M. I. Dias/L. García Sanjuán/M. L. Coutinho/J. A. Lozano Rodríguez/A. Z. Miller/A. W. Pike/C. D. Standish/M. I. Prudêncio/A. L. Rodrigues/J. M. De la Rosa Arranz/D. Gaspar, Landmark of the Past in the Antequera Megalithic Landscape. A Multi-Disciplinary Approach to the Maticabras Rock Art Shelter. *Journal of Archaeological Science* 95, 2018, 76–93.
- Romero Pérez/Fernández Rodríguez 2012*: M. Romero Pérez/L.-E. Fernández Rodríguez, Las fases finales de la Edad del Bronce en el entorno de Antequera. In: E. García Alfonso (ed.), *Diez Años de Arqueología Fenicia en la Provincia de Málaga (2001–2010)* (Sevilla 2012) 263–280.
- Schubart et al. 2000*: H. Schubart/V. Pingel/O. Arteaga Matute (eds.), *Fuente Álamo. Las Excavaciones Arqueológicas (1977–1991) en el Poblado de la Edad del Bronce* (Sevilla 2000).
- Soares/Tavares da Silva 1998*: J. Soares/C. Tavares da Silva, From the Collapse of the Chalcolithic Mode of Production to the Development of the Bronze Age Societies in the South-West of Iberian Península. In: S. Oliveira (ed.), *Existe una Idade do Bronce Atlântico?* (Lisboa 1998) 231–245.
- Suárez Padilla et al. 1995*: J. Suárez Padilla/L.-E. Fernández Rodríguez/F. J. Rodríguez Vinceiro/C. von Thode Mayoral/A. García Pérez/M. Barrera Polo/A. Palomo Laburu, La Peña de los Enamorados de Antequera (Ladera Oeste). Un importante enclave en la Ruta del Genil hacia la Andalucía Oriental. In: *Actas del XXI Congreso Nacional de Arqueología. Volume I* (Zaragoza 1995) 73–84.
- Tovar Fernández et al. 2014*: A. Tovar Fernández/I. Marqués Merelo/S. Jiménez Brobeil/T. Aguado Mancha, Enterramiento colectivo de la Edad del Bronce. El sepulcro excavado en la roca número 14 de la necrópolis de Alcaide (Antequera, Málaga). *Menga. Revista de Prehistoria de Andalucía* 5, 2014, 123–149.
- Valera 2015*: A. C. Valera, Social Change in the Late 3rd Millennium BC in Portugal. The Twilight of Enclosures. The South-West. In: H. Meller/H. W. Arz/R. Jung/R. Risch (eds.), *2200 BC. A Climatic Breakdown as a Cause for the Collapse of the Old World. 7th Archaeological Conference of Central Germany* (October 23–26, 2014, Halle, Saale) (Halle 2015) 409–428.
- Velázquez Bosco 1905*: R. Velázquez Bosco, Cámaras sepulcrales descubiertas en el término de Antequera. *Revista de Archivos. Bibliotecas y Museos* 5, 1905, 1–7.
- Vilaseca Díaz 1990*: F. Vilaseca Díaz, Informe arqueológico del término municipal de Almargen. *Anuario Arqueológico de Andalucía 1987.III*, 1990, 509–512.
- Vilaseca Díaz 1993*: F. Vilaseca Díaz, La estela decorada y la espada de lengua de carpa del Bronce Final de Almargen (Málaga). *Baetica. Estudios de Arte, Geografía e Historia* 15, 1993, 217–226.
- Vilaseca Díaz 1994*: F. Vilaseca Díaz, Aportación al estudio de la iconografía prehistórica. Los ídolos de Almargen y Antequera. *Mainake. Estudios de Arqueología Malagueña* 15–16, 1994, 37–44.

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Natural Resources, Peasant Rationality and Social Spaces in the Border between El Argar and the Valencian Bronze Age Societies

Keywords: Bronze Age, El Argar, Valencian Bronze Age, agriculture, husbandry, social inequality, goods

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Abstract

This paper will analyse the relationships between the two societies located on either side of the Argaric and the Valencian Bronze Age border. Relationships were developed between these communities and the natural environment they used and transformed, and through their immediate intra-social and inter-social spaces.

The analysis of archaeological evidence shows that the economies of both these societies were based on the principles of peasant rationality. However, through the analysis of the degree of population nuclearisation, organisation and distribution, as well as cultural materiality and differential access to certain resources and products, significant differences can be observed. This

enables us to infer that there were not only fundamental differences in the degree of social development between the Argaric and the Valencian Bronze Age societies, but that there were also economic dependencies between both social spaces.

Introduction

The Argaric and Valencian Bronze Age cultures are two of the most recognised and remarkable later prehistory entities of the Iberian Peninsula (Lull 1983; Jover 1999; Aranda et al. 2015). Archaeological investigations have shown the major socio-economic development of the Argaric culture, to the extent that it has been considered as the focus around which the rest of the neighbouring cultures gravitated. Nevertheless, all these societies were based on a subsistence economy of cultivation and raising livestock. These two economic activities were the key for a section of the society to achieve a greater degree of institutionalisation and consolidated the growing social differences. Peasantry was, in this sense, the driving force of this process.

This paper, oriented from a fallibilist perspective and based on the theoretical framework of Social Archaeology (Bate 1998), aims to explore more deeply the economic rationality of the communities that inhabited the border territories between El Argar and the Valencian Bronze Age culture. Research carried out on a number of archaeological sites has provided good quality sequential, contextual and analytical data. Paleoeconomic and

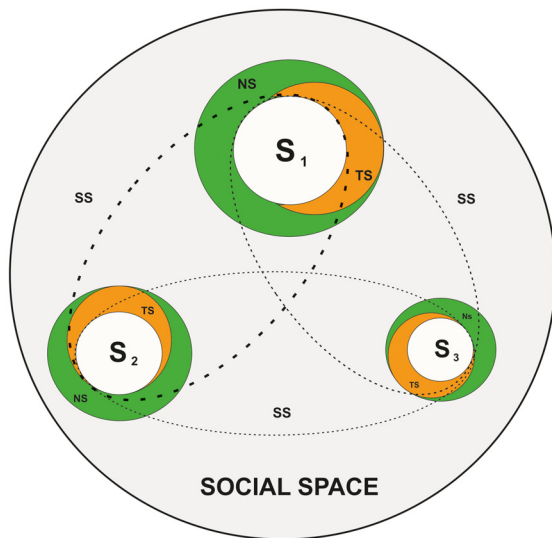


Fig. 1. Theoretical diagram showing settlement units (S) in their social space, with indication of the three spheres of interaction: natural sphere (NS), transformed sphere (TS) and social sphere (SS).

paleoenvironmental studies have enabled us to evaluate and determine which products were obtained directly from the communities' local environment, and which were acquired through inter-societal exchange networks. This analysis can help us understand better the degree of socioeconomic and political development of each of these two social entities.

Theoretical Framework

Working the land was what underpinned the Argaric and Valencian Bronze Age societies, and given that the lands most suitable for agriculture were dispersed, the communities, which established themselves around these lands, were also widely distributed across the landscape. This landscape therefore was predominantly characterised by dispersed villages and farms that were located next to the lands being exploited by each community (Díaz-Polanco 1977; Toledo 1981; 1993).

In terms of production and consumption, each peasant group or production unit had three different spheres of interaction, from which they could obtain the necessary resources to reproduce (Toledo 1981). The first of these was the natural

environment (natural sphere) which was the natural, non-transformed ecosystem, located around the settlement sites, for example forests, steppes, rivers or rocky outcrops. The second was the transformed environment (transformed sphere) which included cultivated lands, pastures, mines and quarries, and finally the social environment (social sphere), which refers to the relationships through productive and reproductive ties with other nearby domestic groups (Toledo 1981, 130) (*fig. 1*).

Through the investment of labour in the natural sphere and transformed sphere each domestic group could obtain sufficient resources for their own consumption, which could be transferred in various ways to the social sphere. These groups would have been established social relationships built on affective relationships, reciprocity, direct symmetrical exchange and deferred exchange. In this way, through established social processes, different products required for sustaining and the social reproduction of the communities would be introduced from the social sphere to each settlement. This economic exchange was established to satisfy the needs of the communities that were not met through the direct interaction of each group with its own ecosystems. In order to achieve this, a part of the production from one community would have been separated from its own consumption and be transferred to the social sphere; and *vice versa*, a part of the consumption of a community would depend on economic exchange.

The rationality of a peasant economy would have been guided by the principle of guaranteeing the reproduction of domestic groups, avoiding the depletion of resources from the natural sphere and transformed sphere. The specialisation of natural spaces and the productive activities associated would also be avoided (Toledo 1993, 209), in a framework of full fixation and appropriation of the social space. This economic strategy, oriented to self-subsistence – not autarchy (Meillassoux 1993, 60) – does not exclude the existence of specialists, for example in the production of metal, textiles or ivory goods, given that this work did not have a negative impact on agricultural practices.

Therefore, it is essential to be able to determine the capacity of these primary producers – the peasantry – to freely generate surplus labour

and surplus product, which could be transferred to society. Or indeed, whether this capacity had been taken away from them by a dominant social group, so that the surplus produced did not revert to society in general, which would be considered social exploitation (Bate 1998; Risch 2002, 26). This difference is essential, because it will determine whether we are referring in the first case to a tribal social formation (Sarmiento 1992) or in the second case to different class societies (Bate 1984; 1998) with different ways of extracting the surplus from the peasant groups.

To maintain and consolidate the exploitation of peasant groups, there needs to be an economic dependency on the social sphere. In other words, there needs to be an increase in the consumption of basic goods, required for their production and reproduction, obtained through the social sphere. This increased dependency could be achieved by increasing and developing the material conditions necessary to participate in social life, for example better tools and new goods with a high social value and group identification value, as well as by dissuading peasant groups from engaging in continual economic exchanges. In this way, defining which raw materials and goods were obtained through the natural sphere and transformed sphere, and conversely, through the social sphere, could become a valid and under explored indicator to determine the degree of economic development and, also, dependency of a given society.

Geography of the Border Area

The study area is located to the northeast of the Baetic System mountain range (Southeast Spain), specifically the areas between the southern Prebaetic System and the Subbaetic System. This area's geography is characterised by the presence of various parallel mountain ranges aligned in a southwest/northeast direction, which define and form poorly developed valleys. Only the Vinalopó tectonic fault enables any southeast to northwest communication between the coast and the interior of the Iberian Peninsula.

It covers an area of about 3,600km², of which approximately 1,200km² – located to the south –

corresponds to the northeastern extension of El Argar occupation, whilst the rest is occupied by the Valencian Bronze Age culture. The Abanilla-Crevillente-Negra-Tabayá mountain range (the closest to the coastal areas) forms the border between the two societies (Jover/López 1997) (fig. 2).

The northeastern Argaric territory studied is delimited by several mountainous areas that enclose the Bajo Segura and Bajo Vinalopó basins. This area is defined geologically by the Orihuela, Dolores-Callosa and Elche floodplains, with more than 35 primary and derivative flint and quartzite deposits, together with two outcrops of igneous rocks and numerous different sedimentary rocks (Jover 1997; 2014). Only one copper deposit is known to have been exploited at Cerro de la Mina in the Sierra de Orihuela (Brandherm et al. 2014).

The areas of the middle and upper reaches of the Vinalopó river and the Seco river are the best-known areas. This is a natural corridor surrounded by various mountain ranges. The Vinalopó river valley is an important area of open floodplains. Here the quaternary sediments from the bottom of the valley should be noted, especially those from the Villena basin, as well as igneous rocks, many siliceous outcrops, sedimentary rocks and clays. However, no copper or silver deposits have been found (Simón 1998).

An integrated program of investigation and analysis has been developed in the study area, which has included geoarchaeological surveys and excavations. The results of these investigations have enabled us to characterise the settlement pattern and to collect important stratigraphic and chronological data. At least 16 settlements, of different sizes and locations, have been excavated, including the Argaric sites of Laderas del Castillo, Tabayá, Pic de les Moreres, Cabezo Pardo, Caramorro I and Illeta dels Banyets; and the Valencian Bronze Age sites of Cabezo Redondo, Terlinques, Barranco Tuerto, El Negret, La Horna, Foia de la Perera, Polovar, Purgaticos and Lloma Redona.

So far, more than 130 absolute dates have been obtained (Jover et al. 2019a). Well-sequenced series of dates have also been obtained from four settlements that have enabled us to propose a periodisation for the whole studied space (Jover et al. 2014).

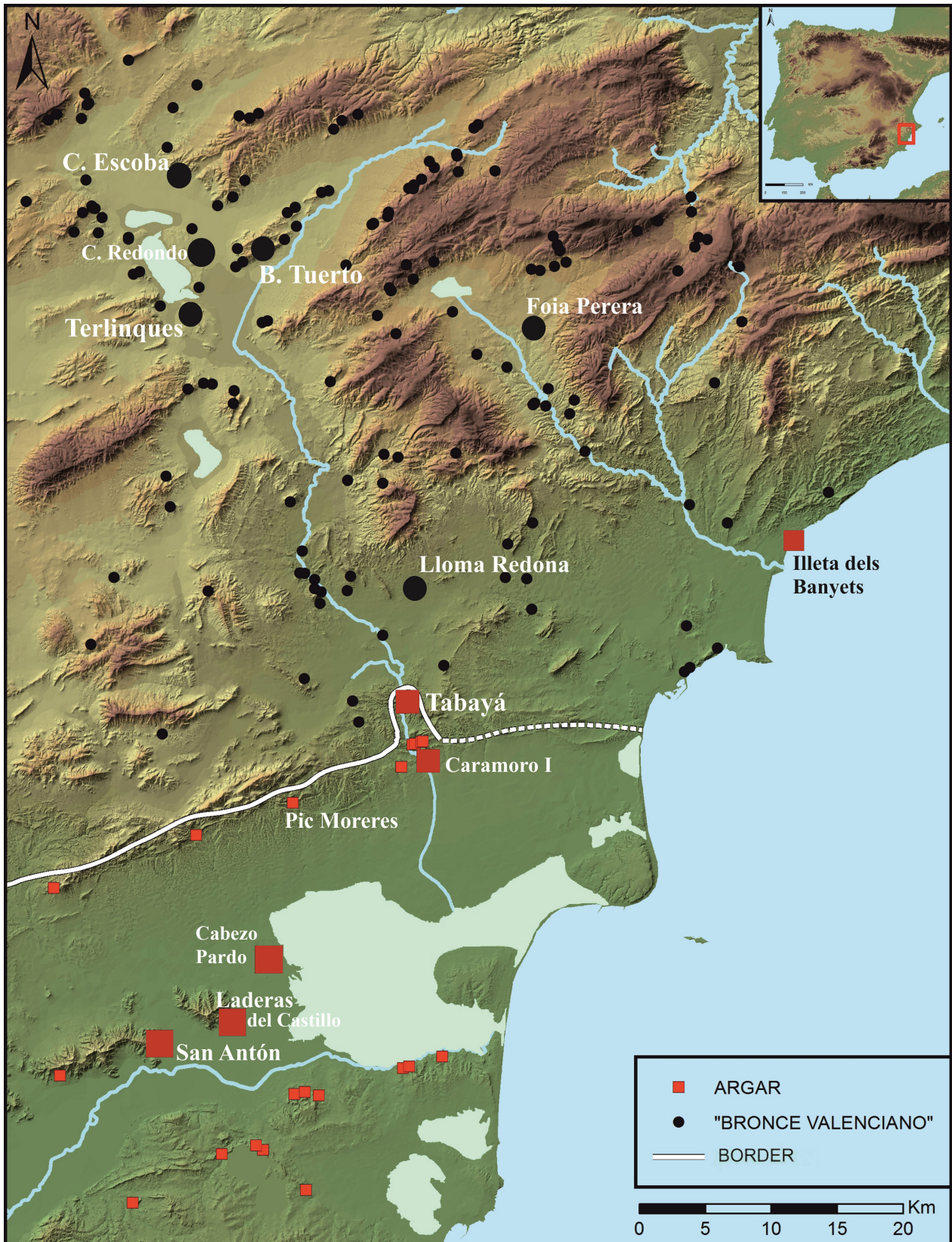


Fig. 2. Map of the two territories studied, showing the main settlements and the border proposed between them, in the province of Alicante.

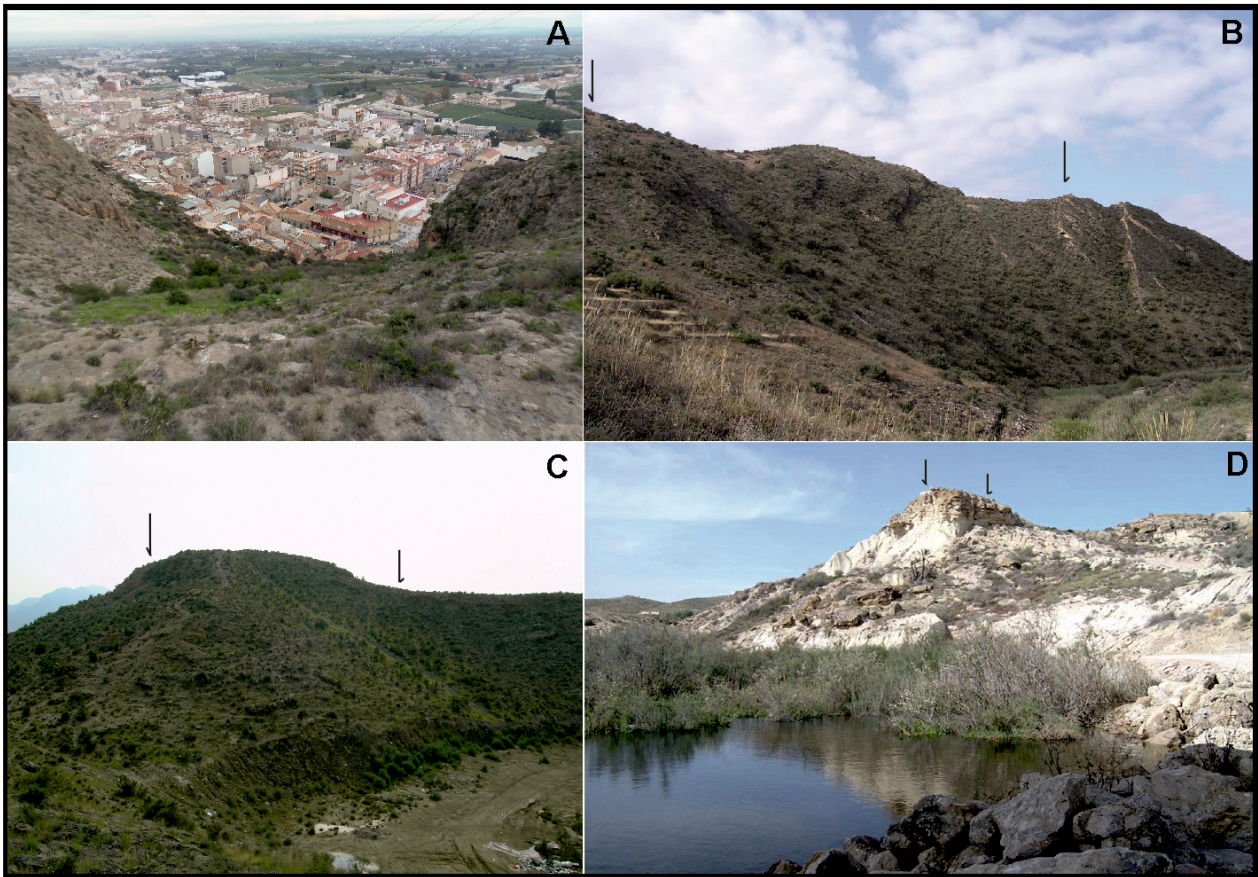


Fig. 3. View of different Argaric sites mentioned in the text: A. Laderas del Castillo; B. Tabayà; C. Cabezo Pardo; D. Caramoro I.

Evidence associated with the demography of the Argaric territories indicates that from the end of the 3rd mill. BC, the settlement pattern was characterised by many dispersed settlements in isolated hills and foothills. In total, 28 settlements have been recorded, located near to the best agricultural land and on mountain passes (*fig. 3*). Four site classifications have been established, defined by their size and material culture (Jover et al. 2019a):

- Settlements with a surface area of ca. 2ha, for example San Antón and Laderas del Castillo (López et al. 2018). These would have been nuclear sites with the longest periods of occupation, from ca. 2200 to ca. 1500 calBC and possibly until 1250 calBC.
- Settlements between 0.5 and 1ha, located on the main communication routes. Settlements, such as Tabayà (Hernández et al. 2019), were occupied for an extensive period of time, similar to the large settlements in the area.

- Settlements between 0.1 and 0.3ha, such as Cabezo Pardo (López 2014). These sites were established ca. 1950 and abandoned ca. 1550 calBC.
- Finally, there is a wide range of smaller sites, less than 0.1ha, with a short occupation period. Included in this group of sites is Caramoro I, recently re-studied and recorded by our research team, with an occupation sequence of less than 250 years, between 2000 and 1750 calBC (Jover et al. 2019b).

In respect to the Valencian Bronze Age culture, more than 150 open-air sites have been recorded, widely distributed over the study area (Jover et al. 2018). They were established mainly on the sides and tops of isolated hills, in the middle of valleys and mountain ridges (*fig. 4*). Unlike the settlements in the Argaric territory, the sites in the Valencian Bronze Age area are much smaller. They have been classified into three types:

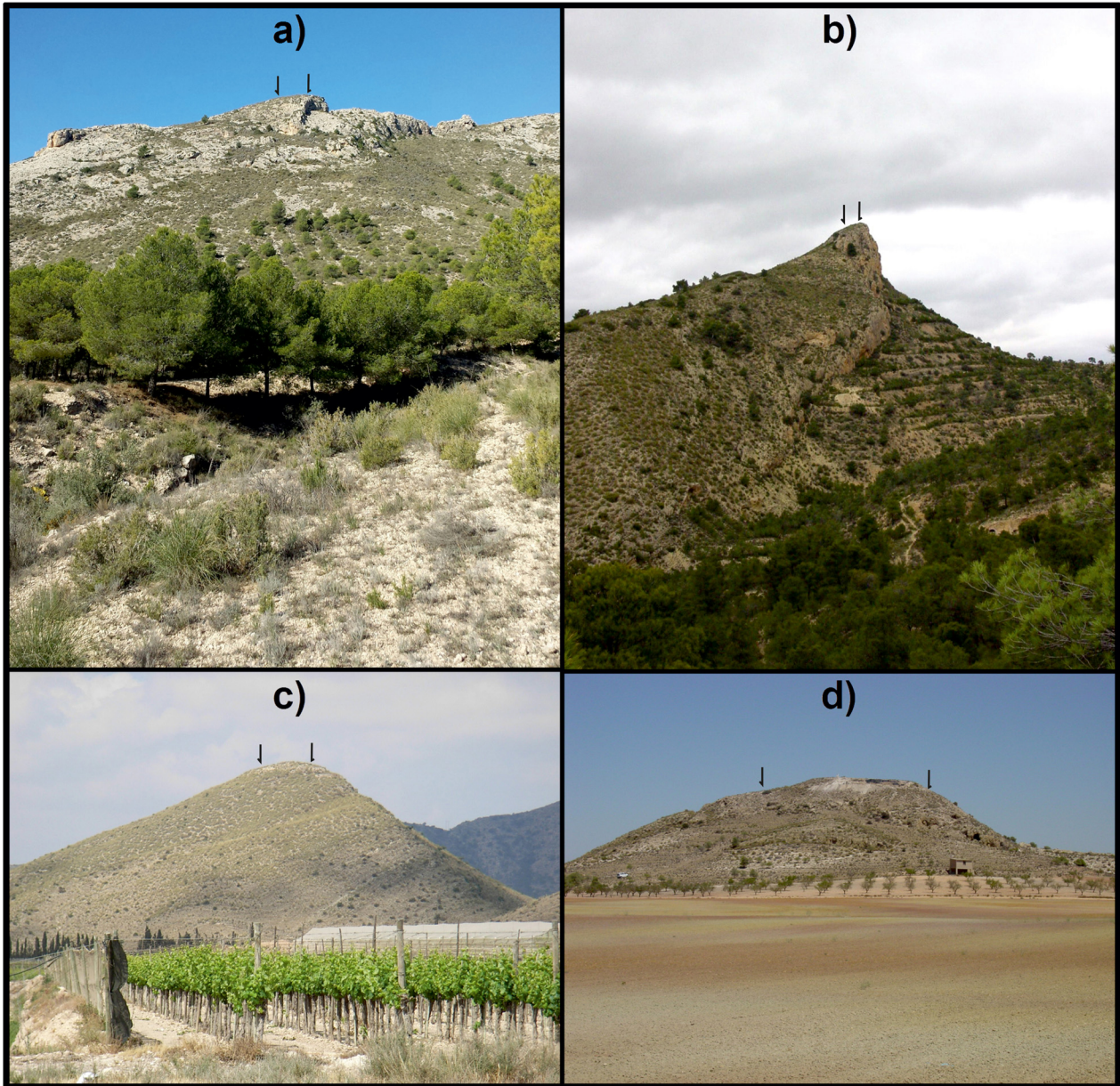


Fig. 4. Valencian Bronze Age sites with different orographic locations. On top of mountain ridges: a) Barranco Tuerto; b) Puntal del Ginebre. On top of hills: c) Lloma Redona; d) Terlinques.

- Settlements between 0.2 and 0.4ha. Seven of these types of settlements have been recorded: Cabezo Redondo, Cabezo de la Escoba, Cabezo del Rosario, la Atalaya, Cabezo de la Virgen 1 (possible site), Portitxol and El Negret. The first five are located in the Villena basin. Excavations and dating carried out on the first two sites indicate that they were occupied for a considerable period of time, between 2150 and 1500 calBC, although Cabezo Redondo (Hernández et al. 2016) reached its peak extent between 1500 and 1250 calBC. The latter three sites were also occupied until the end of the 2nd mill. calBC, however the date of their maximum extent has not been determined.
- Settlements between 0.1 and 0.2ha. These sites are more abundant and, like the larger ones above, were located between five and seven kilometres from each other. There are 14 sites, the majority of which are recorded in the Villena basin. An example of one of these sites is Terlinques (Jover/López 2016), where excavation has shown that it had a long occupation sequence, between 2150 and 1500 calBC.

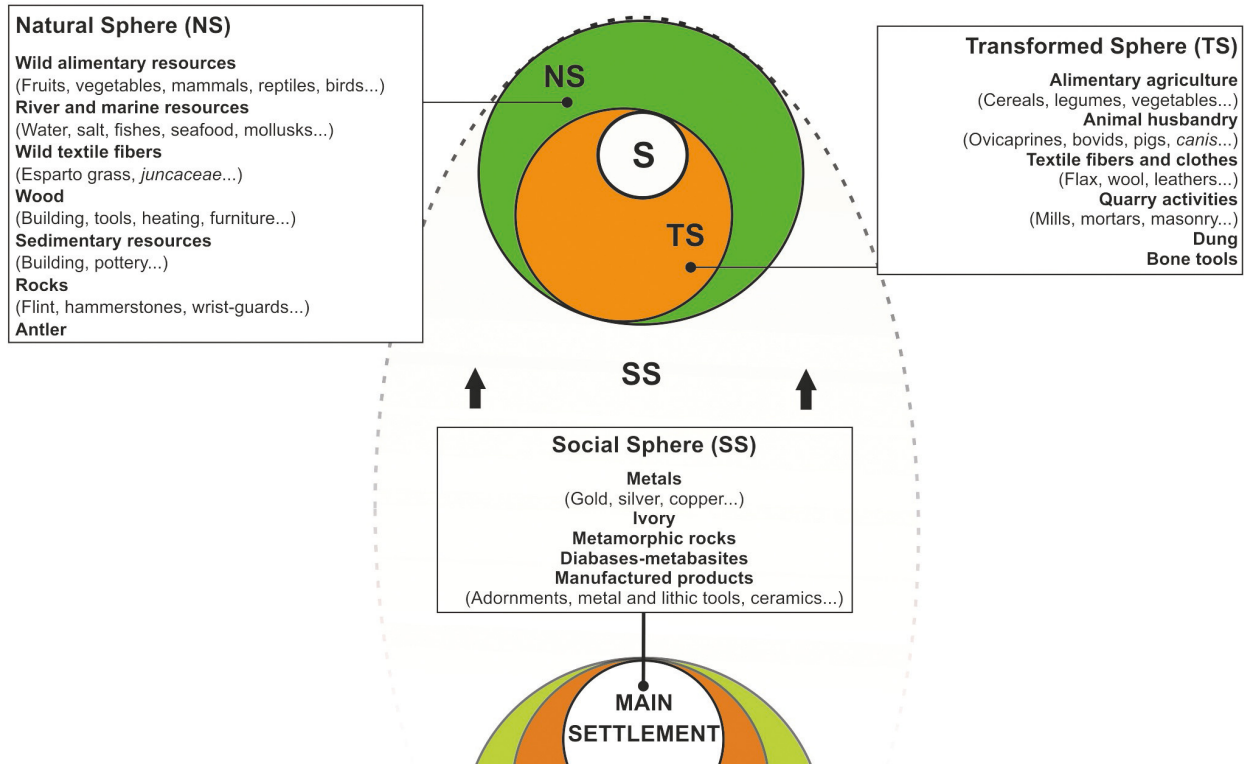


Fig. 5. Diagram showing resources, products and productive activities linked to the three different spheres in a settlement and the relationship with a main settlement.

- Settlements smaller than 0.09ha. There are 130 of these types of sites, with more than 60% of them being smaller than 300m². Some were habitation sites with short occupation sequences, such as Foia de la Perera or Loma Redona (Jover et al. 2018). Others were more like storage areas (Jover et al. 2016), shelters (Jover et al. 2017) or even observation posts to control the territory (Jover/López 2005).

The evidence appears to indicate that the settlement pattern in the southern area of the Valencian Bronze Age culture, between 2150 and 1500 calBC, was characterised by large settlements, between 0.1 to 0.4ha, occupied over a long period of time and equidistantly distributed and located between five and seven kilometres from each other. All the settlements were near agricultural land, water, and other natural resources. Surrounding these large settlements, were smaller sites with a shorter period of occupation, and other secondary sites such as storage areas and shelters (Jover et al. 2018).

There are, therefore, significant differences between the Argaric and the Valencian Bronze Age areas in the organisation of the space occupied.

The size of the settlements, their spatial distribution, and the political control over access to the Argaric space (Jover/López 1999; López 2009; Martínez Monleón 2014), are all significant aspects that differentiate the two cultural areas and suggest that there was a greater degree of social and political development of the Argaric Culture (Jover et al. 2019a).

Resources

Bringing together all the archaeological evidence from the investigated sites, all the data on the resources that are present on either side of the Argaric border have been synthesised. The types of resources that were used, their manner of procurement and the context from which they were acquired, i.e. the natural sphere, transformed sphere, or social sphere, have been identified. A detailed analysis of the material record indicates that almost all the resources come from the natural sphere or transformed sphere surrounding each settlement (fig. 5 and 6).



Fig. 6. Resources and artefacts obtained from the three different spheres of interaction. Natural sphere: a. spindle with juncaceae thread from Terlinques; b. carbonised reed fragments from Cabezo del Polovar, probably used as building material; c. cob units of a built structure from Caramoro I. Transformed sphere: d. carbonised seeds of *Hordeum vulgare* ssp. *vulgare*, *Triticum aestivum-durum*, *Vicia faba*, *Pisum sativum* (Pérez Jordà 2014); e. bone awls from Caramoro I. Social sphere: f. diabase tools from Terlinques; g. ivory bracelets from Caramoro I; h. metal artefacts from Caramoro I; i. gold ear gauge from Cabezo de la Escoba.

In regard to the management of the natural environment transformed (natural sphere and transformed sphere) by each settlement, the main cereal crops cultivated were naked wheat and covered barley (Buxó 1997; Pérez 2013). Evidence of this has been found in various sites, including Terlinques (Jover/López 2016), Cabezo Redondo (Pérez 2016), Cabezo Pardo (Pérez 2014, 304–306), Caramoro I (Alonso, pers. comm.) and Laderas

del Castillo. In Terlinques, isotope analysis suggests that the wheat was enriched with water or was irrigated (Mora et al. 2016). There is also evidence for intensive horticulture, indicated by the presence of peas (*Pisum sativum*) found in the Argaric sites of Caramoro I (Ruíz, pers. comm.) and Cabezo Pardo (Pérez 2014, 304 f.), and beans (*Vicia faba*) in the Valencian Bronze Age sites of Terlinques and Cabezo Redondo (Pérez 2016). Evidence for flax has also been found in various sites (Jover/López 2013): in grave contexts in Tabayá (Hernández et al. 2019) and in domestic spaces, such as Cabezo Redondo. Flax was probably widely cultivated.

These communities, regardless of their size, combined cultivation with raising livestock depending on their needs. A herd of mostly sheep and goats was complemented by cows and pigs. Meat, milk, skin, and bone would have been widely used, together with a range of secondary products, creating a full and integrated husbandry management strategy (Martínez Valle/Iborra 2001/2002; Rizo 2009; Benito 2014). This also resulted in the production of a large number of bone tools and adornments, such as awls, scrapers, arrowheads or chisels. Their manufacture was dependant on the morphology of the bones available.

There is also evidence for the intensive use of wild resources that were found in the environs of the settlements, through extensive hunting, fishing and gathering. Evidence for hunting deer, boar, horse and in particular rabbit, has been found (Benito 2014; Andúgar 2016). Fresh and saltwater fishing was also practiced. Amongst the wide variety of fished species, barbel should be highlighted, which has been found on sites such as Cabezo Redondo, Caramoro I and Cabezo Pardo (Roselló/Morales 2014; Soler García 1986; Marlasca 2019).

In both cultural areas other natural resources were gathered, in particular acorns, which have been found in large quantities in Terlinques (Jover/López 2016), Cabezo Redondo (Pérez 2016) and Laderas del Castillo (López et al. 2017; 2018). Other species recorded include olives, wild grapes (*Vitis*) and fruit from the madrone tree (*Arbutus unedo*), as well as many others that were used for cooking or had medicinal properties (Soler García 1986; Pérez 2013). Similarly, plant fibres were

also gathered. Esparto grass was used to produce rope, basketry and clothing, and was also used as a building material (Jover/López 2013). Biotic and abiotic resources, available near to the settlements, were often implemented as building materials (Martínez Mira et al. 2014). This includes canes, reeds (Pastor 2014) and mud, which was used as a mortar and as render for massive earth walls (Pastor et al. 2018).

Analysis to determine the provenance of lithic materials has shown that tools were manufactured from locally available stone (Jover 1997; 2009; 2014). Only diabase (dolerite) came from sources further afield, between 20 and 35km away, which suggests the existence of regional distribution networks (Jover 1997; Orozco 2000). XRD and thin-section analysis of a large number of ceramic assemblages from various sites show that almost all the pottery was produced locally on site (Seva 2002). Only in a very few sites within the Argaric territory, and always being less than 2% of the total ceramic assemblages, vessels with inclusions not found in the immediate area were recorded, but these inclusions were still found locally, usually within a few kilometres.

As well as some lithics and the pottery inclusions mentioned above, a number of resources were obtained through networks established as part of the social sphere. These include the exchange and distribution of shells, other types of stone, ivory and metals.

Bivalve shells or marine gastropods have been recorded across the sites studied, even those that are more than 100km away from the coast, such as Cerro de El Cuchillo (Barciela 2006). All these malacological resources were gathered post-mortem in coastal areas and were used to manufacture adornments (Luján 2014). Large numbers of shells were distributed widely across the territories.

Metamorphic rocks, most notably fibrolite, also circulated in both the Argaric and Valencian Bronze Age territories and were probably coming from the southeast Iberian Peninsula (Orozco 2000).

Ivory, mainly from elephant but also some from hippopotamus, was abundant, manufactured into buttons, bracelets and pendants (López 2011). Their presence is more significant in the Argaric

lands than in the Valencian Bronze Age ones. So far, only one production workshop has been identified in the coastal site of Illeta dels Banyets (López 2011).

There was more variation in the types of copper, bronze (which became more abundant from 1800 calBC [Montero et al. 2019]), gold and silver implements recorded. Settlements would have had access to basic implements such as awls, chisels, knives and arrowheads, and in some cases small axes and saws. However, large axes and halberds are only present in some Argaric sites. These objects, which may also be considered as weapons, have only been found in Tabayá, Laderas and San Antón (Simón 1998). Copper or bronze hoops, rings, and wristbands were common adornments in the Argaric culture as well as in the Valencian Bronze Age culture. This is not however the case for silver and gold adornments, which have only been found in graves in the largest Argaric settlements of San Antón, Laderas, and Tabayá, where a silver diadem was found (Simón 1998). Silver and gold rings, hoops, wristbands, beads, and spirals have been found on these sites, but are absent in smaller Argaric enclaves and in Valencian Bronze Age territories. Silver hoops, as well as other types of jewellery, which are considered as being completely Argaric in style, begin to appear from 1750 calBC in the area of the Valencian Bronze Age culture being researched. The gold ear gauge from Cabezo de la Escoba (Cabezas 2015) is a good example of this. This type of jewellery has only been found in high status graves.

The only metalliferous vein found in these areas is at Cerro de la Mina (Santomera, Murcia) and the few isotopic studies carried out up to now suggest that most of the metals came from further afield (Brandherm et al. 2014, 124 f.). Similarly, the evidence so far suggests that smelting activities would have been carried out in the larger Argaric and Valencian Bronze Age sites. That is indicated by the presence of moulds, crucibles and smelting residues in the Argaric sites of Tabayá, Laderas del Castillo and San Antón and the Valencian Bronze Age sites of Cabezo de la Escoba and Cabezo Redondo (Simón 1998). No evidence of these types of finds have been found in the smaller sites excavated.

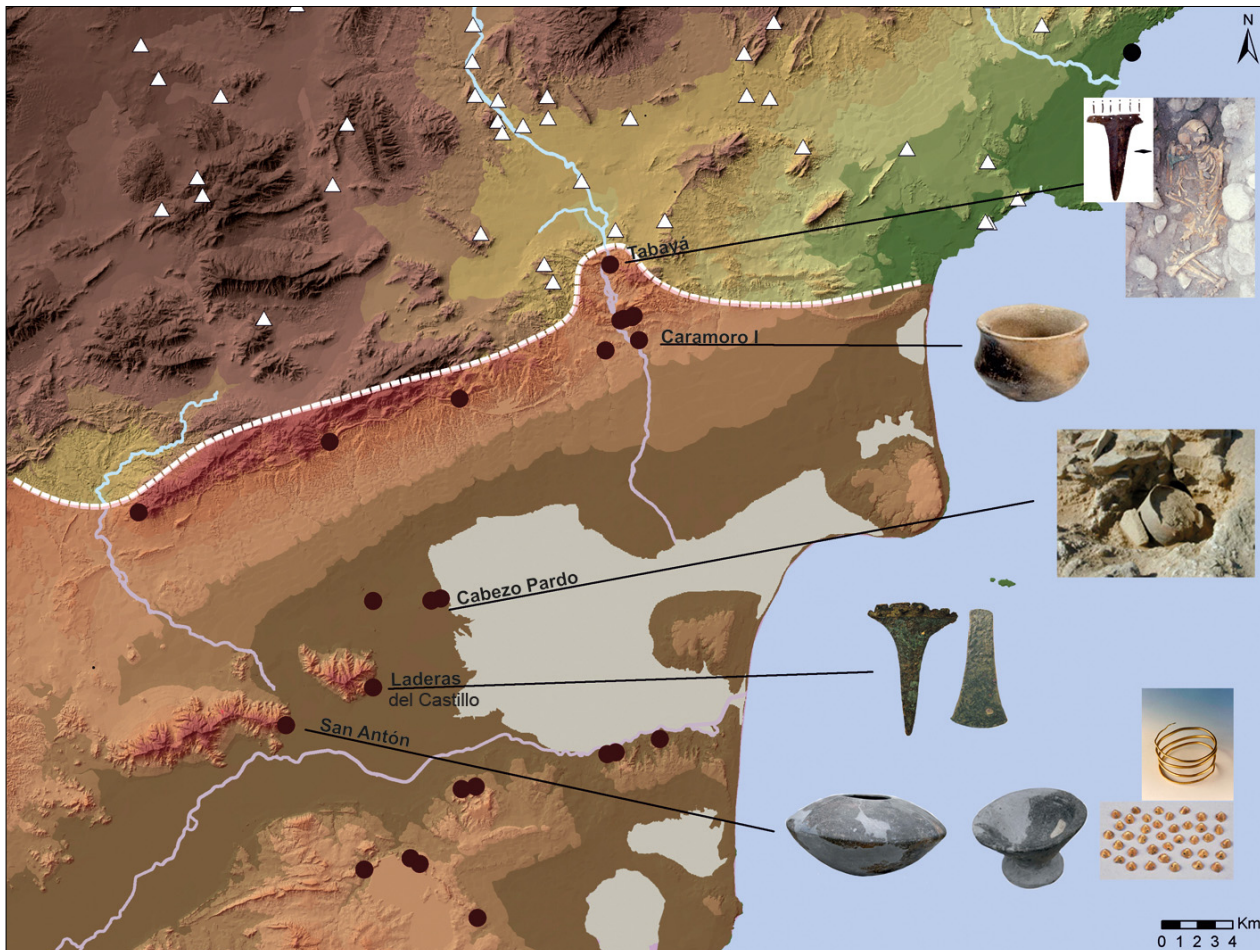


Fig. 7. Map of the Argaric area studied with indication of some of the most remarkable materials recovered in the sites mentioned, in the province of Alicante.

Conclusion

Research carried out in the border territories of the Argaric and the Valencian Bronze Age cultures shows that the settlement landscape of both societies was based on peasant communities. Even though the settlements were established near agricultural lands, the characteristics of their location in inaccessible places – on promontories, slopes and hills – allow to consider that protection of the community and its production – cultivation and raising livestock – would have been a priority for these societies. In this agricultural landscape, the local natural and transformed resources (natural sphere and transformed sphere) would have been exploited according to peasant rationality, avoiding their depletion. However, although the majority of the communities' needs would have been met by these locally available resources, each domestic group would have

required various goods that were essential for their social reproduction.

As it has been shown, the larger sized settlements, between 0.1 and 0.4ha, were uniformly and almost equidistantly distributed within the Valencian Bronze Age area. Smaller settlements, between 0.03 and 0.1ha, were established around the larger sites, and in turn farms and similar small sites were located around these. They were settled primarily near the more productive agricultural lands and sources of water, with other more logistical focused sites placed in strategic locations with good visibility to be able to control the territories (Jover et al. 2018).

In contrast, the panorama in the northeastern areas of the Argaric territory is more complex. Here a more concentrated settlement pattern has been recorded, with a smaller number of settlements that are more densely populated. Although different settlement groups can be identified

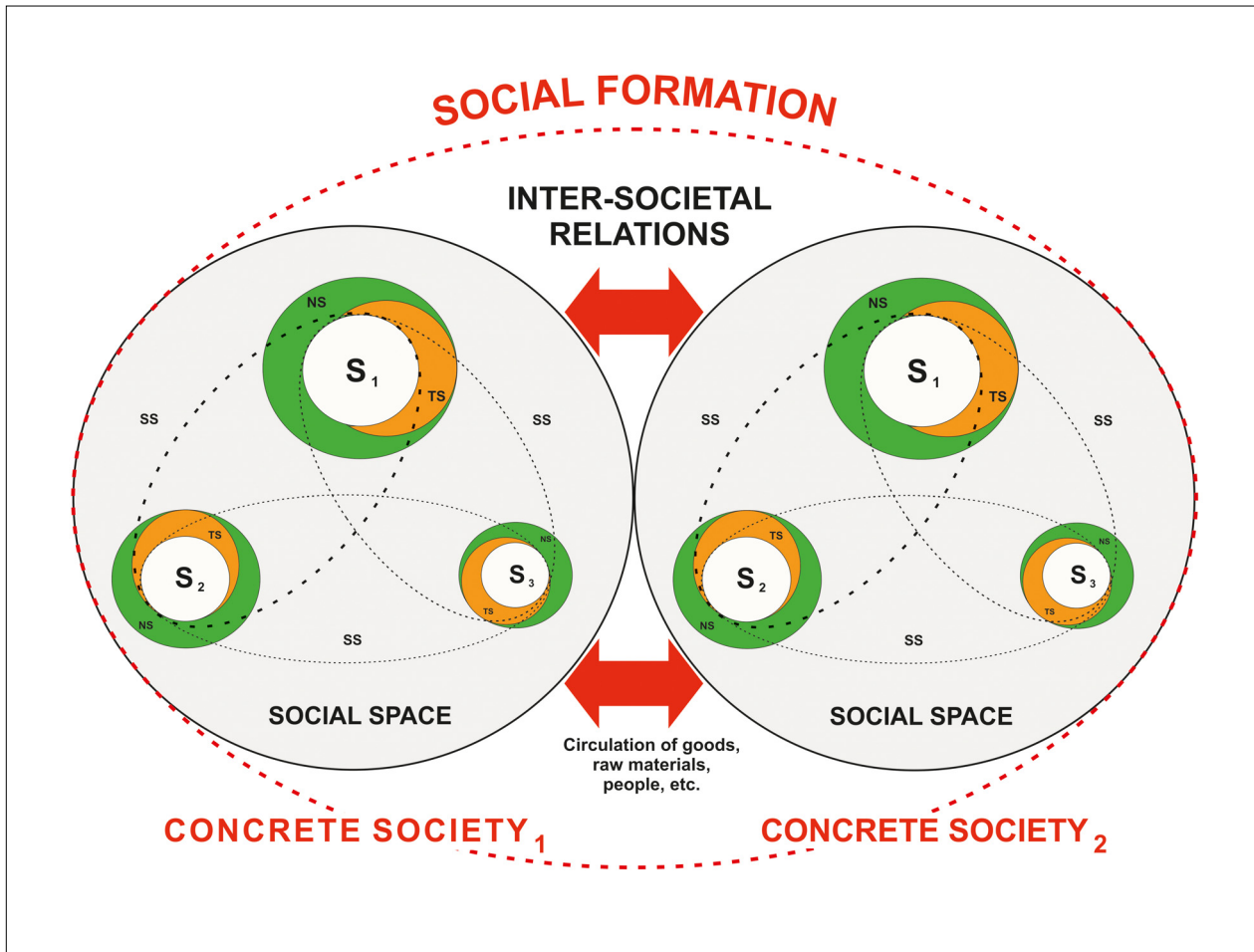


Fig. 8. Theoretical representation of the dialectical relation between two concrete societies and their social spaces.

according to size (between 0.06 and 2.5ha) the territory was organised around a few large settlements, with a larger number of smaller, variable sized sites. They were located both near to agricultural lands and at some distance from them in strategic locations, giving them control over communication routes. The newly established Argaric settlements are located close to earlier Bell Beaker period sites. This change in the settlement pattern is probably not so much due to the need to adapt to the environment, nor due to the exploitation of new or different resources, but relates to a political re-organisation linked to a new model of territorial control (Jover et al. 2019a).

The principles that formed this landscape were those of the rationality of peasant economy based on self-subsistence, environmental sustainability and the exploitation of all the available resources without depleting them or economic specialisation (Jover 1999). This is shown by the comprehensive

exploitation of all types of resources and the wide array of economic practices that have been recorded on all sites (hunting, fishing, gathering, etc.). For almost 1000 years, there were no significant changes or improvements in working tools apart from the use of copper alloys. In any case, these would have been peasant communities that tended towards self-sufficiency, obtaining all their basic needs from local resources.

However, in the Argaric society, the evidence points to an attempt by the elites to control the peasant communities, the main element of their productive system. Through generations, only a few individuals – adults and children – living in the larger main settlements, had access to gold and silver adornments. And of these, only a few men were capable of being buried (*fig. 7*) with high status weapons, such as halberds and ivory handled knives. This evidence supports the idea that the dominant social groups had taken part

of the surplus work and product of the peasant groups through various distribution processes and economic exchange.

Likewise, the dialectical relation established between the border communities of the Valencian Bronze Age and the northeastern groups of El Argar could have been driven by two fundamental aspects. The first was the need of the Valencian Bronze Age society to have access to metals and ivory, which were not available in their social space, for the elaboration of tools and adornments. The second was the capacity of the Argaric groups to control the production, distribution and exchange of these higher social value goods. The privileged position of the Argaric elites would have given them the ability to determine the exchange value of the goods to be exchanged or of those to be received. Clearly, such economic exchange would imply the appropriation of the surplus value by the Argaric elites (*fig. 8*).

In conclusion, in order to increase social differences and consolidate their position of privilege, the dominant groups, of both social spaces, although predominantly the Argaric elites, would have endeavoured to increase the dependency of the peasant groups by controlling the economic exchange of instruments of labour and goods that were necessary for production and for their social reproduction. That control would imply a more dependent relation of these groups with the social sphere, by creating and increasing their

requirements, and, in the case of El Argar, through the concentration of large populations in a few habitation sites. In our view, this is what essentially differentiates the social organisation in the Argaric and Valencian Bronze Age areas.

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Bibliography

- Andúgar 2016*: L. Andúgar, Análisis faunístico de los conjuntos calcolíticos y argáricos de Gatas (Turre, Almería) y La Bastida (Totana, Murcia) (PhD-Thesis Universitat Autònoma de Barcelona), <<https://www.tesisenred.net/handle/10803/385722#page=1>> (last access 20.02.2019).
- Aranda et al. 2015*: G. Aranda/S. Montón-Subías/M. Sánchez, *The Archaeology of Bronze Age Iberia. Argaric Societies* (London 2015).
- Barciela 2006*: V. Barciela, *Los elementos de adorno del Cerro del Cuchillo (Almansa, Albacete). Estudio tecnológico y funcional* (Albacete 2006).
- Bate 1984*: L. F. Bate, Hipótesis sobre la sociedad clasista inicial. *Boletín de Antropología Americana* 9, 1984, 47–87.
- Bate 1998*: L. F. Bate, *El proceso de investigación en arqueología* (Barcelona 1998).

- Benito 2014*: M. Benito, La fauna argárica de Cabezo Pardo. In: J. A. López (coord.), Cabezo Pardo (San Isidro Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 260–288.
- Brandherm et al. 2014*: D. Brandherm/A. Maass/M. Müller-Kissing/E. Diz, Prospecciones arqueomineras en la Sierra de Orihuela. In: Museo Arqueológico de Alicante (ed.), Orihuela. Arqueología y museos (Alicante 2014) 114–125.
- Buxó 1997*: R. Buxó, Arqueología de las plantas (Barcelona 1997).
- Cabezas 2015*: R. Cabezas, El Cabezo de la Escoba (Villena, Alicante). Revisión de un asentamiento de la Edad del Bronce en el corredor del Vinalopó (Villena 2015).
- Díaz-Polanco 1977*: H. Díaz-Polanco, Teoría marxista de la economía campesina (Mexico 1997).
- Hernández et al. 2019*: M. S. Hernández/J. A. López/F. J. Jover Maestre, Estratigrafía y radiocarbono. La tumba 1 y la cronología de la ocupación argárica del Tabayá (Aspe, Alicante). Spal. Revista de Prehistoria y Arqueología 28.1, 2019, 35–55.
- Jover 1997*: F. J. Jover, Caracterización de las sociedades del II milenio ANE en el Levante de la Península Ibérica. Cultura, modos de trabajo, modo de vida y formación social (PhD-Thesis Universidad de Alicante 1997), last updated 13.10.1997, <<http://rua.ua.es/dspace/handle/10045/6901>> (last access 20.04.2019).
- Jover 1999*: F. J. Jover, Una nueva lectura del “Bronce Valenciano” (Alicante 1999).
- Jover 2009*: F. J. Jover, La colección de instrumentos líticos de San Antón y Laderas del Castillo. In: M. S. Hernández/J. A. Soler Díaz /J. A. López (eds.), En los confines del Argar. Una cultura de la Edad del Bronce en Alicante en el centenario de Julio Furgús (Alicante 2009) 110–123.
- Jover 2014*: F. J. Jover, Cabezo Pardo. El instrumental lítico del asentamiento argárico. In: J. A. López (ed.), Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 135–178.
- Jover/López 1997*: F. J. Jover/J. A. López, Arqueología de la muerte. Prácticas funerarias en los límites septentrionales de El Argar (Alicante 1997).
- Jover/López 1999*: F. J. Jover/J. A. López, Una nueva propuesta del alcance espacial septentrional de las prácticas sociales argáricas. In: Gobierno de la Región de Murcia/Instituto de Patrimonio Histórico (eds.), XXIV Congreso Nacional de Arqueología (Cartagena) 1997.2 (Murcia 1999) 275–286.
- Jover/López 2005*: F. J. Jover/J. A. López, Barranco Tuerto. El proceso histórico en el II milenio cal BC en las tierras del Vinalopó. Vestigium 1 (Villena 2005).
- Jover/López 2013*: F. J. Jover/J. A. López, La producción textil durante la Edad del Bronce en el cuadrante suroriental de la península Ibérica. Materias primas, productos, instrumentos y procesos de trabajo. Zephyrus 71, 2013, 149–171.
- Jover/López 2016*: F. J. Jover/J. A. López, Nuevas bases para el estudio de las comunidades campesinas de la Edad del Bronce en el Levante peninsular. El asentamiento de Terlinques (Villena, Alicante). In: E. Bonet (ed.), Del Neolítico a l’Edat de Bronze en el Mediterrani occidental. Estudis en homenatge a Bernat Martí Oliver (Valencia 2016) 427–450.
- Jover et al. 2014*: F. J. Jover/J. A. López/G. García-Donato, Radiocarbono y estadística bayesiana. Aportaciones a la cronología de la Edad del Bronce en el extremo oriental del Sudeste de la península Ibérica. Saguntum 46, 2014, 41–69.

- Jover et al. 2016*: F. J. Jover/S. Martínez/M. Pastor/E. Poveda/J. A. López, Los asentamientos de pequeño tamaño de la Edad del Bronce en tierras valencianas. A propósito del Cabezo del Polovar (Villena, Alicante). *Recerques del Museu d'Alcoi* 25, 2016, 47–68.
- Jover et al. 2017*: F. J. Jover/J. Moratalla/S. Martínez/G. Segura, Poblados, cuevas, cobertizos y refugios de la Edad del Bronce. La aportación del cerro de los Purgaticos (La Canyada, Alicante). *Saguntum* 49, 2017, 7–29.
- Jover et al. 2018*: F. J. Jover/S. Martínez/J. A. López, Sobre la estructura poblacional de las sociedades del sur del Bronce Valenciano. *Zephyrus* 82, 2018, 93–117.
- Jover et al. 2019a*: F. J. Jover/J. A. López/G. García, Territory, Settlements and Households. Chalcolithic and Bronze Age in the Eastern Iberian Peninsula (2800–1500 cal BC). In: H. Meller/S. Friederich/M. Küßner/H. Stäuble/R. Risch (eds.), *Siedlungsarchäologie des Endneolithikums und der frühen Bronzezeit*. 11. Mitteldentscher Archäologentag vom 18. bis 20. Oktober 2018 in Halle (Saale). *Tagungen des Landesmuseums für Vorgeschichte* 20.2 (Halle 2019) 1003–1028.
- Jover et al. 2019b*: F. J. Jover/M. Pastor/R. E. Basso/S. Martínez/J. A. López, Secuencia de ocupación y desarrollo constructivo del asentamiento de Caramoro I (Elche, Alicante). *Aportaciones a la arquitectura argárica*. *Arqueología de la Arquitectura* 16, 2019, e083.
- López 2009*: J. A. López, El grupo argárico en los confines orientales del Argar. In: M. S. Hernández/J. A. Soler/J. A. López (eds.), *En los confines del Argar. Una cultura de la Edad del Bronce en Alicante en el centenario de Julio Furgús* (Alicante 2009) 246–267.
- López 2011*: J. A. López, Asta, hueso y marfil. Artefactos óseos de la Edad del Bronce en el Levante y Sureste de la península Ibérica (c. 2500–1300 cal BC). *Museo Arqueológico de Alicante. Serie Mayor* 9 (Alicante 2011).
- López 2014*: J. A. López, Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. *Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas* (Alicante 2014).
- López et al. 2017*: J. A. López/F. J. Jover/S. Martínez/A. Sánchez/A. Luján/M. Pastor/R. E. Basso, El Argar allicantino. La Edad del Bronce en el Bajo Segura y Bajo Vinalopó. In: *Museo Arqueológico de Alicante* (ed.), *Tomad y bebed. Una copa para un ritual milenario* (Alicante 2017) 65–85.
- López et al. 2018*: J. A. López/F. J. Jover/S. Martínez/A. Sánchez/M. Pastor/R. E. Basso/A. Luján, Los toros de arcilla de Laderas del Castillo. In: J. A. López/F. J. Jover (coord.), *Los toros de El Argar. Figurillas de arcilla de la Edad del Bronce* (Alicante 2018) 5–19.
- Luján 2014*: A. Luján, La malacofauna de Cabezo Pardo y el aprovechamiento de los recursos malacológicos durante la Edad del Bronce. In: J. A. López (coord.), *Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce*. *Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas* 6 (Alicante 2014) 241–259.
- Lull 1983*: V. Lull, La “cultura” de El Argar. Un modelo para el estudio de las formaciones económico-sociales prehistóricas (Barcelona 1983).
- Marlasca 2019*: R. Marlasca, La explotación de los recursos pesqueros en la costa mediterránea de la península ibérica. Del Neolítico a la época ibérica. In: J. L. Pascual/A. Sanchís (eds.), *Recursos marinos en el passat. IV Jornades d'Arqueozologia del Museu de Prehistòria de València* (Valencia 2019) 135–164.
- Martínez Valle/Iborra 2001/2002*: R. Martínez Valle/P. Iborra, Los recursos agropecuarios y silvestres en la Edad del Bronce del Levante peninsular. In: M. S. Hernández (ed.), *...Y acumularon tesoros. Mil años de Historia en nuestras tierras* (Alicante 2001/2002) 221–230.

- Martínez Mira et al. 2014*: I. Martínez Mira/E. Vilaplana/I. Such/J. Juan/M. A. García, Cabezo Pardo. Análisis instrumental de materiales de construcción de barro del yacimiento argárico. In: J. A. López (coord.), Cabezo Pardo (San Isidro/Granja de rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 330–378.
- Martínez Monleón 2014*: S. Martínez Monleón, El Argar en el Bajo Segura y Bajo Vinalopó. Patrón de asentamiento en un territorio de frontera (Villena 2014).
- Meillassoux 1993*: C. Meillassoux, Mujeres, graneros y capitales (México 1993).
- Montero et al. 2019*: I. Montero/M. Murillo-Barroso/D. Hood, La producción de bronce durante El Argar. Frecuencia y criterios de uso. Boletín del Museo Arqueológico Nacional 38, 2019, 9–26.
- Mora et al. 2016*: A. Mora/A. Delgado/A. Granados/F. Contreras/F. J. Jover/J. A. López, The Isotopic Footprint of Irrigation in the Western Mediterranean Southeast Iberian Peninsula. Vegetation and History Archaeobotany 25, 2016, 459–468.
- Orozco 2000*: T. Orozco, Aprovisionamiento e intercambio. Análisis petrológico del utillaje pulimentado en la Prehistoria recientes del País Valenciano (España). British Archaeological Reports. International Series 867 (Oxford 2000).
- Pastor 2014*: M. Pastor, Cabezo Pardo. Contribución a las formas constructivas de un hábitat argárico a partir del estudio de los elementos de barro. In: J. A. López (coord.), Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 306–321.
- Pastor et al. 2018*: M. Pastor/F. J. Jover/S. Martínez/J. A. López, La construcción mediante amasado de barro en forma de bolas de Caramoro I (Elche, Alicante). Identificación de una nueva técnica constructiva con tierra en un asentamiento argárico. Cuadernos de Prehistoria y Arqueología de la Universidad Autónoma de Madrid 44, 2018, 81–99.
- Pérez 2013*: G. Pérez, La agricultura en el País Valenciano entre el VI y el I milenio a.C. (PhD-Thesis Universitat de València 2013), <<http://roderic.uv.es/handle/10550/31152>> (last access 18.02.2019).
- Pérez 2014*: G. Pérez, Cabezo Pardo. Los materiales carpológicos de época argárica. In: J. A. López (ed.), Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 303–306.
- Pérez 2016*: G. Pérez, Registro carpológico en el Cabezo Redondo. Agricultura y recolección. In: M. S. Hernández/G. García/V. Barciela (eds.), Cabezo Redondo (Villena, Alicante) (Alicante 2016) 106–107.
- Risch 2002*: R. Risch, Recursos naturales, medios de producción y explotación social. Un análisis económico de la industria lítica de Fuente Álamo (Almería), 2250–1400 antes de nuestra era. Iberia Archaeologica 3 (Mainz am Rhein 2002).
- Rizo 2009*: C. Rizo, Ganadería y caza durante la Edad del Bronce. Arqueozoología del Tabayá (Aspe, Alicante) (Villena 2009).
- Roselló/Morales 2014*: E. Roselló/A. Morales, La ictiofauna de época argárica de Cabezo Pardo. In: J. A. López (ed.), Cabezo Pardo (San Isidro/Granja de Rocamora, Alicante). Excavaciones arqueológicas en el yacimiento de la Edad del Bronce. Museo Arqueológico de Alicante. Memorias de Excavaciones Arqueológicas 6 (Alicante 2014) 289–302.
- Sarmiento 1992*: G. Sarmiento, Las primeras sociedades jerárquicas (México 1992).
- Seva 2002*: R. Seva, Caracterización cerámica y relaciones culturales en la Prehistoria reciente de Alicante (PhD-Thesis Universidad de Alicante 2002).

Simón 1998: J. L. Simón, La metalurgia prehistórica valenciana. Servicio de Investigación Prehistórica. Serie de Trabajos Varios 93 (Valencia 1998).

Soler García 1986: J. M. Soler, Excavaciones arqueológicas en el Cabezo Redondo (Villena, Alicante) (Alicante 1986).

Toledo 1981: V. Toledo, Intercambio ecológico e intercambio económico en el proceso productivo primario. In: L. Laff (ed.), Biosociología y articulación de las ciencias (México 1981) 115-147.

Toledo 1993: V. Toledo, La racionalidad de la economía campesina. In: E. Sevilla/M. González de Molina (eds.), Ecología, campesinado e historia. Genealogía del poder 22 (Madrid 1993) 197-218.

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Culture-Based Dietary Patterns in Megalithic and Argaric Bronze Age Societies in Southeastern Iberia

Keywords: funerary ritual, Iberian Peninsula, megalithic phenomenon, Argaric societies, stable isotope analysis, dietary patterns

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Abstract

Cultural diversity does not only occur in the long-term but also among social groups that coexisted chronologically and spatially. This is the case of the megalithic societies that coexisted from approximately 2200 calBC onwards with the Argaric Bronze Age communities in southeastern Iberia. These groups differ markedly in their mortuary rituals. In addition to the continuity and reuse of earlier collective megalithic cemeteries, there were individual inhumations inside settlements. Palaeodietary analyses offer an excellent opportunity for a better understanding of this cultural diversity. The carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) composition of a sample of 194 individuals belonging to three

megalithic cemeteries (Los Millares, El Barranquete and Panoría) and to four Argaric settlements (Cerro de la Virgen and Cuesta del Negro, Gatas and La Bastida) are analysed and compared. The results led to four main conclusions:

- (i) subsistence strategies in both megalithic and Argaric populations were based on a mixed economy of herding and farming without any relevant consumption of aquatic resources (marine and freshwater);
- (ii) megalithic societies evidence a rather homogeneous dietary pattern in contrast to the greater inter-individual variability found among Argaric peoples;
- (iii) the consumption of domesticated animals and dairy products has increased during the El Argar period, although access to such high-quality foodstuffs would have been rather asymmetrical;
- (iv) in contrast to the Argaric societies, the contemporary megalithic Bronze Age communities had a more conservative dietary pattern, emphasising the continuity of traditional consumption habits.

1. Introduction

Before moving to the comparative analysis of subsistence practices between the Argaric and megalithic populations through palaeodietary analysis, it is worthwhile to contextualise how the study of these societies has been approached. Prehistoric societies have frequently been considered

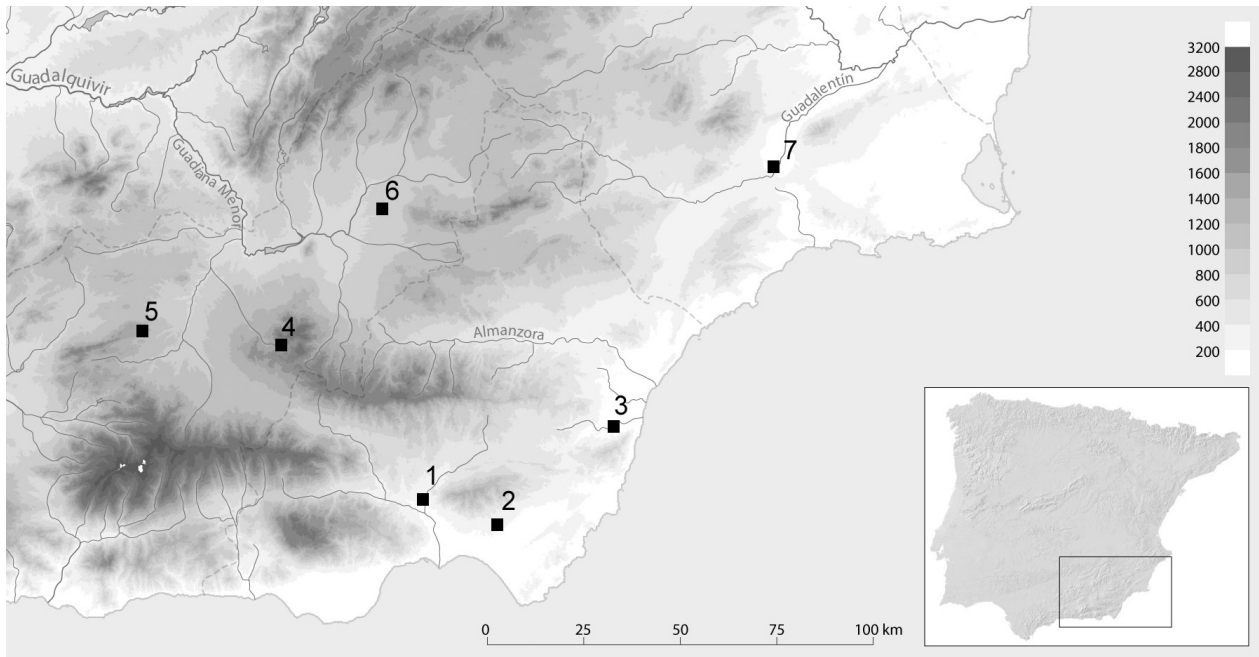


Fig. 1. Map showing the main sites mentioned in the text. 1. Los Millares; 2. Barranquete; 3. Gatas; 4. Cuesta del Negro; 5. Panoría; 6. Cerro de la Virgen; 7. La Bastida (modified after Aranda Jiménez et al. 2015).

as homogeneous in terms of their cultural and ethnic identities. Cultural variability has mainly been found in the long-term analysis that has traditionally been approached from an evolutionary perspective and would have involved the replacement of certain cultural forms with others. It has thus been assumed that the beginning of a new way of life would have meant the end of the previous one. On many occasions, this assumption also implies an organic notion of social evolution based on the cyclical recurrence of periods of formation, growth, plenitude, crisis and disappearance (Aranda Jiménez 2015).

Within this theoretical framework, social practices associated with the continuity and permanence of different cultural traditions were considered typical of marginal communities or, alternatively, of societies in the process of ‘acculturation’. This explanatory category, commonly used in the study of transitional periods, entails the unilateral transference of cultural influences in which the social group that receives them always adopts a receptive and passive position. This theoretical perspective emphasises the notion of linear evolution and cultural progress in which outlier social practices were properly

settled into evolutionary discourses. The narratives regarding the Early Bronze Age societies in southeastern Iberia – known as the Argaric Culture (ca. 2200–1550 calBC) – can be considered as an outstanding example of this kind of theoretical approach (Chapman 2008; Lull et al. 2013; Aranda Jiménez et al. 2015).

However, in recent years, we have focused our attention on the study of the Argaric outliers, specifically on the permanence of one of the most characteristic features of the Chalcolithic societies: megalithic monuments. In 2012 a radiocarbon dating programme aimed at exploring the chronology and timing of the megalithic phenomenon in this region was undertaken (*fig. 1*). As a result, a new series of 120 radiocarbon dates was produced, a significant development, especially if it is considered that up to 2012 only twelve dates had been published. This new series has contributed to the change of many traditional assumptions and to the formulation of fresh hypotheses (Aranda Jiménez et al. 2017; 2018a; 2018b; 2020a; 2020b; 2021; Aranda Jiménez/Lozano Medina 2014; Lozano Medina/Aranda Jiménez 2017; 2018).

One of the most remarkable contributions was the importance attained for the continuity

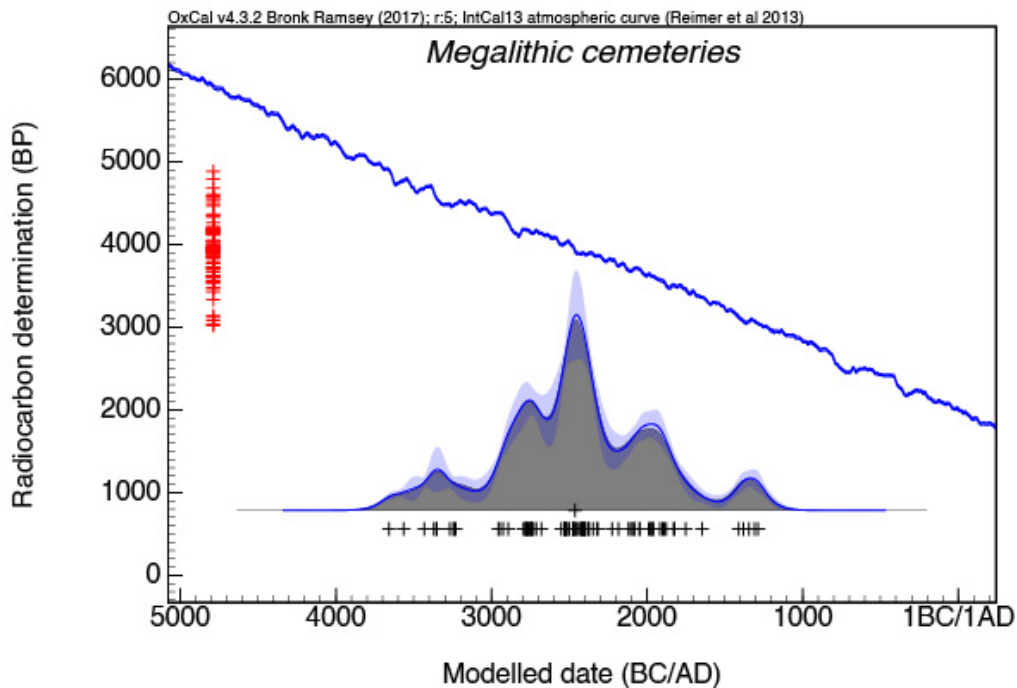


Fig. 2. KDE-modelled distributions of dates from the megalithic tombs of southeastern Iberia.

and reuse of megalithic graves during the Bronze Age. Funerary practices in traditional collective tombs spread across the whole Argaric geography and timespan. The distribution of the radiocarbon dates does not show any interruption or hiatus around 2200 calBC, when different cultural innovations led to the appearance of the Argaric societies. On the contrary, the radiocarbon series shows that the megalithic mortuary rituals were intensively used until the end of the Bronze Age (*fig. 2*). Most surprisingly, in megalithic cemeteries such as El Barranquete 50% of the radiocarbon dates ($n=46$) belong to Bronze Age people. Even in specific cases such as Tomb 9, all the dates ($n=14$) except one belong to the Argaric Bronze Age (Aranda Jiménez/Lozano Medina 2014; Aranda Jiménez et al. 2018a; 2020b). This scenario challenges the supposed cultural uniformity of Argaric societies and the sharp discontinuity with the previous Chalcolithic communities.

This means that two very different mortuary and ritual practices coexisted in the Argaric period: an earlier tradition comprising the continuity and reuse of collective megalithic cemeteries and a new mortuary ritual of individual inhumations

inside the settlements, normally below house floors (*fig. 3*). This funerary diversity could be associated with culturally different communities: the Argaric societies characterised by the development of a stratified society (Lull/Risch 1995; Gilman 2001; 2013; Chapman 2008; Lull et al. 2009; 2011; Cámara Serrano/Molina González 2011; Bartelheim 2012; Ramos Millán 2013) and those social groups that emphasised more collective, relational identities and that would not have self-identified as Argaric people (Aranda Jiménez et al. 2018a; 2020b; Lozano Medina/Aranda Jiménez 2018).

For a better understanding of this ritual and its cultural diversity, the subsistence practices of the Argaric and megalithic populations were explored through palaeodietary analysis. Thus, the aim of this paper is to discuss the cultural implications of the differences and similarities found in the diets of people carrying out different funerary and cultural practices. In the following sections, the different palaeodietary studies available for these populations will be discussed from a comparative perspective in the context of the social dynamics of the megalithic and Argaric communities of southeastern Iberia.



Fig. 3. Mortuary rituals diversity. Tomb 3 from the megalithic necropolis of Panoría (top) and Tomb 9 at the Argaric site of Cerro de la Encina (bottom) (Photographs from the Department of Prehistory at University of Granada).

2. Palaeodietary Studies in Southeastern Iberia

Isotopic analyses based on carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) composition are routinely undertaken on human bone collagen in order to explore dietary inputs; principally to investigate the protein intake and to understand the trophic level, the consumption of marine and freshwater resources, and to discriminate between C_3 and C_4 plants (e.g. Schoeninger et al. 1983; Schoeninger/DeNiro 1984; Ambrose 1993; Froehle et al. 2012). Carbon and nitrogen isotopes are mainly derived from protein in bone collagen, which means that the dietary components reflected in the isotopic ratios tend to be more influenced by the intake of animal-derived foodstuffs in which the protein values are higher. Carbon isotope values primarily reflect atmospheric conditions affecting plants at the base of the food web, while for nitrogen isotopes both the soil composition and the trophic level of the consumer are important. The increase of the heavy isotopes along food chains would have involved a relationship between higher nitrogen values and higher proportions of meat and dairy consumption.

Multi-isotopic studies have been revealed worldwide as an excellent pathway for a better understanding of dietary patterns. Research into southeastern Iberia has recently joined to this general trend. For the study of megalithic societies, the first approach to the carbon and nitrogen isotope composition was based on a sample of ten individuals from Los Millares cemetery (Waterman et al. 2017). This palaeodietary study included the isotope ratios of the two elements that comprise the skeletal tissues: organic protein (collagen) and inorganic minerals (apatite). In a more recent study, the dietary pattern of two megalithic cemeteries such as El Barranquete and Panoría were explored (Díaz-Zorita Bonilla et al. 2019). The study of the human population found at these sites was approached through two main proxies: i) multi-isotopic determinations that include not only the traditional carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) values but also sulphur ($\delta^{34}\text{S}$) isotopic composition, an indicator used specifically for exploring the consumption of aquatic resources (Nehlich 2015);

and ii) a high-resolution dating framework that includes the radiocarbon dating of all samples isotopically analysed. As a result, the isotopic diet determination was successfully measured for 51 samples: 32 from El Barranquete and 19 from Panoría. With this new isotopic series as a basis, it has been possible to explore the general dietary patterns of these societies and their differences in terms of inter-cemetery comparison and between the isotopic ratios of people belonging to the Chalcolithic and Bronze Age periods.

The palaeodietary study of the Argaric societies has also benefited from several recent contributions. In the inland regions of southeastern Iberia, the sites of Cerro de la Virgen and Cuesta del Negro stand out with 28 and 36 individuals studied respectively (Molina González et al. 2016; 2019). For the coastal regions and as part of a comprehensive study aimed at reconstructing dietary patterns and farming strategies, 69 human individuals from the sites of La Bastida ($n=48$) and Gatas ($n=21$) were also analysed (Knipper et al. 2020). These palaeodietary studies share a main goal in addition to the general characterisation of human diets through carbon and nitrogen isotopic composition. Dietary patterns were used to explore sex, age and social status according to the differences found in grave goods. Argaric funerary offerings range from burials containing no grave goods at all to those with a rich panoply of mortuary objects. Such variations in funerary furnishings have been interpreted as clear proof of a stratified society and the analysis of human diet has been understood as an excellent proxy to test these differences.

The overall sample considered in this paper comprises 194 individuals, 61 from megalithic burials and 133 from Argaric tombs. These samples belong to four Argaric and three megalithic sites located in one of the driest regions of Europe with annual average precipitation of less than 400mm and large inter-annual variations in the amount and duration of rainfall. Palaeoclimatic proxies suggest that the temperature and rainfall conditions were similar to those of today, perhaps with slightly higher values. Palynological and anthracological studies indicate a rapid change towards arid conditions and a landscape characterised by

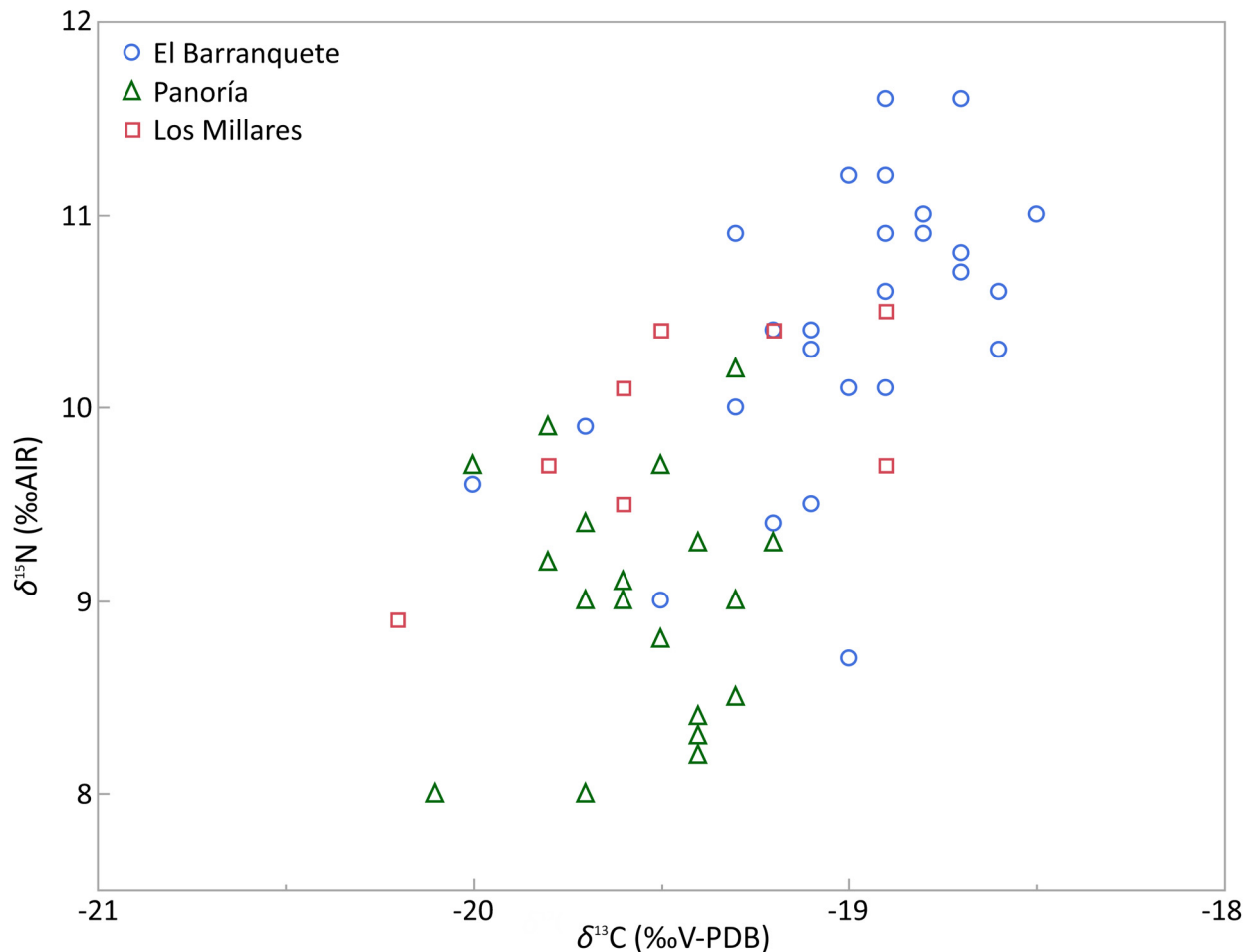


Fig. 4. Distribution of carbon and nitrogen isotope compositions from the megalithic populations.

Mediterranean shrubland and species from arid and saline environments. Forest areas, mainly pine trees, would have been restricted to the mountain areas (Rodríguez-Ariza et al. 1996; Rodríguez-Ariza 2000; Carrión et al. 2003; 2004; 2007; Pantaleón-Cano et al. 2003; Anderson et al. 2011; Schirmacher et al. 2020).

3. Palaeodietary Comparison between Megalithic and Argaric Populations

3.1. Megalithic Populations

Stable isotope values for the megalithic population (n=61) for $\delta^{13}\text{C}$ range from -20.2 to -18.5‰ (average $-19.2 \pm 0.4\text{‰}$, 1σ) and for $\delta^{15}\text{N}$ from +8 to +11.6‰ (average $+9.8 \pm 0.9\text{‰}$, 1σ). If only adults (n=55) are considered to avoid breastfeeding and weaning signals, the values range from

-20.2 to -18.5‰ (average $-19.2 \pm 0.4\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and from +8 to +11.6‰ ($+9.9 \pm 0.9\text{‰}$, 1σ) for $\delta^{15}\text{N}$. Even if we do consider the subadults, the ranges and mean values are similar, which would suggest that there are no individuals on breastfeeding process and that the diet is already homogeneous for all individuals regarding age.

For a more detailed study, the isotopic differences between the three megalithic cemeteries can also be approached. In order to avoid any intra-site enriched $\delta^{15}\text{N}$ values, only juvenile and adult individuals were considered (fig. 4). For El Barranquete (n=28) $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ isotopic values range from -20 to -18.5‰ (average $-19.0 \pm 0.3\text{‰}$, 1σ) and from +8.7 to +11.6‰ (average $+10.3 \pm 0.7\text{‰}$, 1σ) respectively. In the case of Panoría (n=19), isotopic composition ranges from -20.1 to -19.2‰ (average $-19.5 \pm 0.2\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and +8 to +10.2‰ for $\delta^{15}\text{N}$ (average $+9.0 \pm 0.6\text{‰}$, 1σ). For Los Millares (n=8), isotopic markers range from -20.2 to -18.9‰

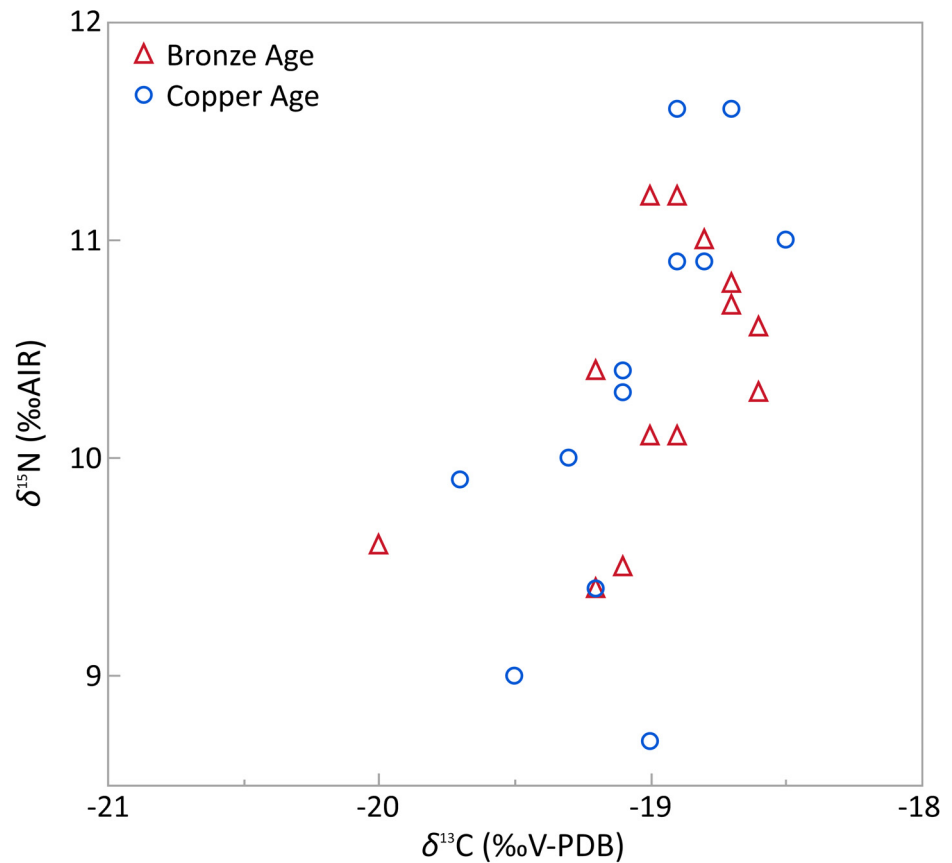


Fig. 5. Distribution of carbon and nitrogen isotope values from Chalcolithic and Bronze Age individuals at El Barranquete cemetery.

(average $-19.4 \pm 0.4\text{‰}$, 1σ) and $+8.9$ to $+10.5\text{‰}$ (average $+9.9 \pm 0.5\text{‰}$, 1σ) respectively for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. The isotopic data by cemeteries show two main aspects. Firstly, the main difference can be found in the nitrogen values between the coastal sites of Los Millares and El Barranquete and the inland cemetery of Panoría. The variability in environmental factors on a local scale may be driving these inter-cemetery differences. Secondly, all the isotopic markers show a low standard deviation (average $<1\text{‰}$). Thus, the isotopic values appear to evidence a rather uniform dietary pattern between the three megalithic cemeteries, especially the coastal sites of Los Millares and El Barranquete.

As has been previously highlighted, in the case of the El Barranquete and Panoría cemeteries all the samples were also radiocarbon dated, which means that dietary inputs can be explored according to chronological and cultural differences (Díaz-Zorita Bonilla et al. 2019). For this purpose, the adult and juvenile age of groups were split into two main groups: one of 30 individuals from the Chalcolithic – 12 from El Barranquete

and 18 from Panoría – and another group of 14 from the Bronze Age, all from El Barranquete. To avoid the setting variability between cemeteries, only the samples from El Barranquete were considered for comparison. In this case, the isotopic values for the Chalcolithic population range from -19.7 to -18.5‰ ($-19.0 \pm 0.3\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and from $+8.7$ to $+11.6\text{‰}$ ($+10.3 \pm 0.9\text{‰}$, 1σ) for $\delta^{15}\text{N}$, and for the Bronze Age group for $\delta^{13}\text{C}$ from -20.0 to -18.6‰ (average $-18.9 \pm 0.3\text{‰}$, 1σ) and for $\delta^{15}\text{N}$ from $+9.4$ to $+11.2\text{‰}$ (average $+10.3 \pm 0.6\text{‰}$, 1σ) (fig. 5). Carbon and nitrogen compositions show remarkably similar signals that are in keeping with a homogeneous dietary pattern between the Chalcolithic and Bronze Age individuals.

3.2. Argaric Populations

Isotopic determinations for the Argaric people ($n=133$) range from -20.1 to -17.3‰ (average $-18.9 \pm 0.5\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and from $+7.3$ to $+14.2\text{‰}$ (average $+10.8 \pm 1.4\text{‰}$, 1σ) for $\delta^{15}\text{N}$. If only adult and juvenile individuals ($n=82$) are taken into

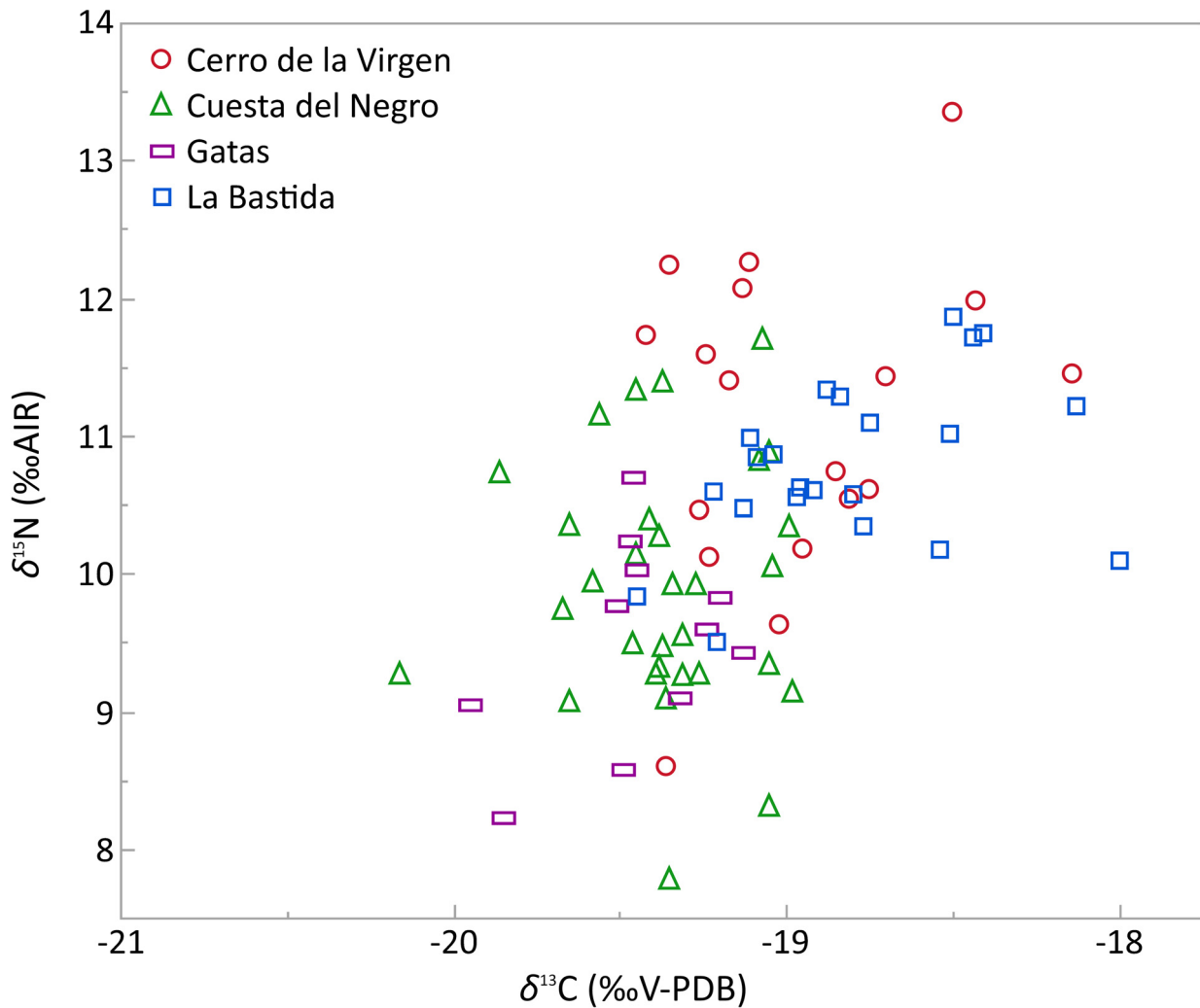


Fig. 6. Distribution of carbon and nitrogen isotope compositions from the Argaric populations.

account, the isotopic values range from -20.1 to -18.0‰ (average $-19.1 \pm 0.4\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and from +7.7 to +13.3‰ (average $+10.4 \pm 1.0\text{‰}$, 1σ) for $\delta^{15}\text{N}$. In this case, the removal of the breastfeeding and weaning signals has significantly affected the isotopic averages. In contrast to the previous megalithic population, two main aspects can be underlined. Firstly, there is an increase in the nitrogen isotopic values from an average of $+9.8 \pm 0.9\text{‰}$ for megalithic populations to $+10.8 \pm 1.4\text{‰}$ for the Argaric societies, which means a difference of $\sim 1\text{‰}$ that is statistically significant (Student's *t*-test: $t=3.06293$; $p=0.0027$). Secondly, the large standard deviation, mainly for $\delta^{15}\text{N}$ (2.8‰), would suggest a higher variability in protein intake among the Argaric peoples.

With regard to inter-site comparisons and excluding the child age group, the isotopic values

for sites located in the inner regions of southeastern Iberia ranged at Cerro de la Virgen ($n=18$) from -19.4 to -18.1‰ (average $-18.9 \pm 0.3\text{‰}$, 1σ) and from +8.6 to +13.3‰ (average $+11.3 \pm 1.1\text{‰}$, 1σ), and at Cuesta del Negro ($n=31$) from -20.1 to -18.9‰ (average $-19.3 \pm 0.2\text{‰}$, 1σ) and +7.7 to +11.7‰ (average $+9.9 \pm 0.9\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ respectively. In the coastal area of southeastern Iberia, La Bastida ($n=22$) ranged from -19.4 to -18.0‰ (average $-18.8 \pm 0.3\text{‰}$, 1σ) and +9.5 to +11.8‰ (average $+10.7 \pm 0.6\text{‰}$, 1σ) and Gatas ($n=11$) from -19.9 to -19.1‰ (average $-19.4 \pm 0.2\text{‰}$, 1σ) and +8.2 to +10.7‰ (average $+9.5 \pm 0.7\text{‰}$, 1σ) for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values (fig. 6). The variability in the isotopic values is probably the main feature of the inter-site comparison. In the case of La Bastida and Gatas, the differential composition has been associated with different agriculture and husbandry

strategies. The higher nitrogen values of the La Bastida population would be related to the consumption of meat from domesticated animals that were fed with a major contribution of cereals and their by-products. In contrast, at Gatas the lower nitrogen isotopic composition matches with domestic herbivores and pigs that fed mostly on wild plants in the surroundings of the site (Knipper et al. 2020).

As has been previously noted, the Argaric funerary ritual based mainly on individual inhumations with important differences in their grave goods has stimulated the study of the positive or negative correlations between dietary habits and sex, age and social status. Regarding the age category, the main difference can be found between children and adults at sites such as La Bastida. The former exhibit values that are significantly higher in $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ than those of adults, specifically for children aged lesser than three years. The isotopic composition for males and females shows a negative correlation in the different datasets analysed, which would mean similar consumption patterns. The correlation with social categories shows a very heterogeneous scenario. At La Bastida, the individuals that, according to the grave goods, held the highest social status, also show the highest $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$. The correlation between the other social categories is negative. At Gatas, the correlation of the isotopic composition with social categories is also negative (Knipper et al. 2020). At Cuesta del Negro, although the tendency is towards higher values of $\delta^{15}\text{N}$ among those individuals with the most important grave goods, the differences between social categories are again rather blurred (Molina González et al. 2019). At Cerro de la Virgen, as at Gatas, the covariation is also negative and the differences in the funerary ritual do not correlate with dietary patterns (Molina González et al. 2016).

3.3. Discussion

According to the isotopic composition, the megalithic and Argaric populations have two main aspects in common. Firstly, the diet was largely based on C_3 plants and terrestrial animals. In southeastern Iberia, staple crops of C_4 plants such

as millet had not been cultivated so far during the Copper and Bronze Ages. Only some influence of C_4 plants that grow naturally in the region has been suggested in several domestic animals that show high $\delta^{13}\text{C}$ values (Knipper et al. 2020; Díaz-Zorita Bonilla et al. 2020). Secondly, the isotopic markers of the different datasets analysed are consistent with a diet with no relevant consumption of marine or freshwater resources, despite the proximity of most of the sites to the Mediterranean coast (Díaz-Zorita Bonilla et al. 2019; Knipper et al. 2020; Aranda Jiménez et al. 2020a; 2021). The occasional, even opportunistic, marine and freshwater protein consumption is also supported by the faunal assemblage found in the settlement of Los Millares. Of the more than 28,000 faunal bone remains studied, only eight fish bones from four different species have so far been identified (Peters/von den Driesch 1990). Thus, carbon and nitrogen values are broadly consistent with a diet based on cereal farming and the consumption of meat and dairy products.

Nevertheless, the comparison between the megalithic and Argaric populations still leaves scope for exploring several noteworthy differences (fig. 7). Large standard deviations for isotopic signals point to fairly heterogeneous inter-individual diets. This seems to be the case among the Argaric populations, which show a standard deviation in nitrogen isotopic values of 2.8‰, an increase of 1‰ compared to the megalithic societies. These differences suggest a development of the variability in protein intake among the Argaric peoples. Access to food resources appears to have changed during the Bronze Age.

Comparison between the megalithic and Argaric populations shows close $\delta^{13}\text{C}$ values, which implies the same C_3 open ecosystem, as well as an increase in $\delta^{15}\text{N}$ values of 1‰ during the Argaric period. Enriched nitrogen values may be attributable to different sources. As has been previously noted, it is very unlikely that the consumption of C_4 plants and freshwater or marine resources could explain this enrichment. The consumption of pig could also have increased the carbon ratios in human consumers due to their omnivorous diet. Nevertheless and according to the faunal remains studied for different Argaric sites, pigs would have played only a minor role in the animal husbandry

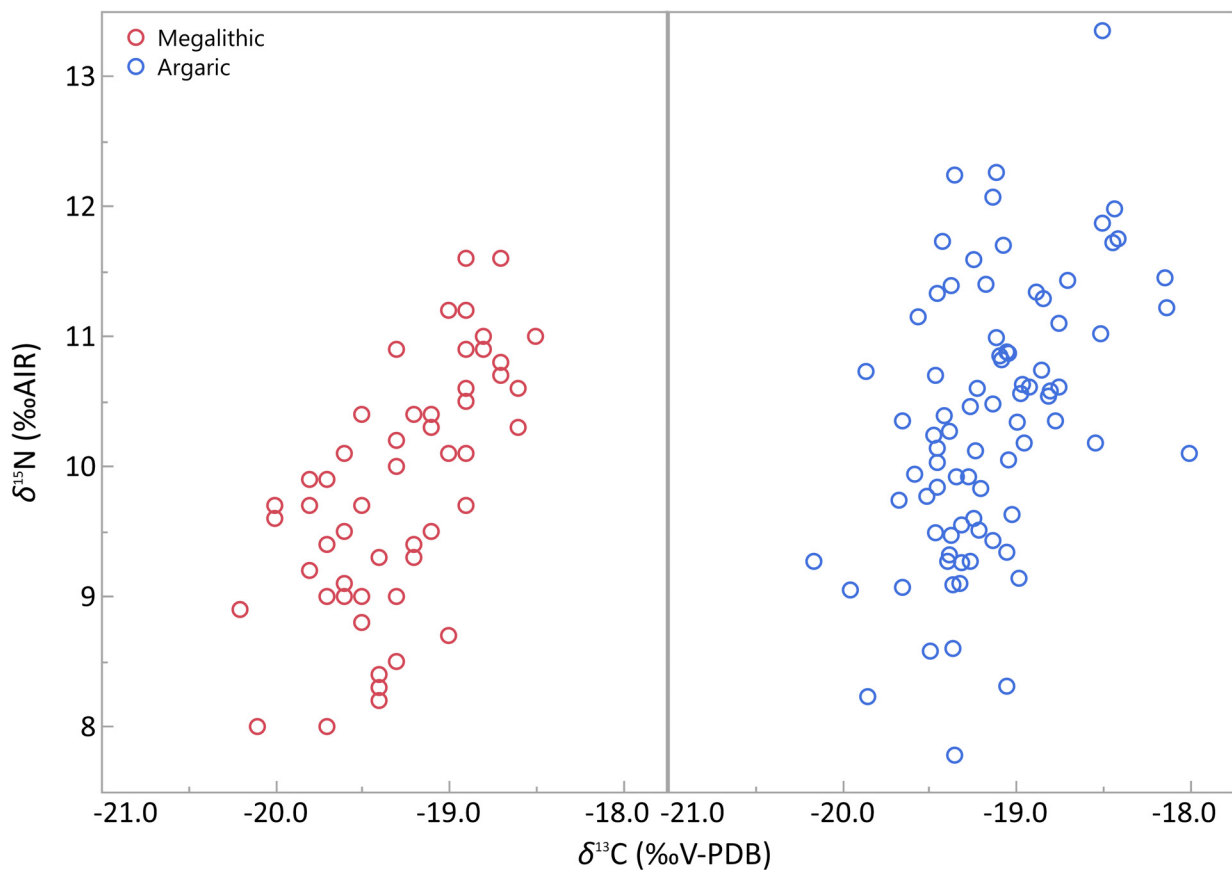


Fig. 7. Comparison of the carbon and nitrogen isotope compositions between Megalithic and Argaric populations.

(Aranda Jiménez et al. 2015). Their consumption does not seem to have been a major source of protein intake. Neither do the differences in husbandry strategies, pointed out as a reason for the nitrogen variability between La Bastida and Gatas (Knipper et al. 2020), explain the general $\delta^{15}\text{N}$ enrichment. It appears that the consumption of domesticated animals and dairy products would have increased during the El Argar period, although the new consumption patterns would have been rather asymmetrical in social terms.

When comparing the Chalcolithic and Bronze Age populations found in the El Barranquete cemetery, the isotopic composition shows a homogeneous dietary pattern. This scenario changes when the comparison is made between the megalithic Bronze Age and Argaric populations that coexisted chronologically and spatially. Although the small sample size from the megalithic Bronze Age ($n=16$) prevents any robust conclusions, the isotopic composition of the Argaric populations confirms larger standard deviations and an

enrichment of nitrogen values. The Bronze Age megalithic populations seem to have maintained more conservative dietary habits connected with a traditional way of life exhibited in the reuse of earlier collective megalithic monuments.

4. Conclusions

Although carbon and nitrogen isotopes in bone collagen are mainly derived from protein intake, environmental and anthropogenic factors may blur direct explanations. Therefore, it is simplistic to suggest that isotopic signals only reflect diet. For a better understanding of these factors, the whole trophic chain should be considered. In particular, human isotopic composition must be compared to that of terrestrial herbivores and omnivores to provide baseline data on the local ecosystems. For southeastern Iberia, the available baselines are rather limited, mainly to the Chalcolithic societies. In spite of these drawbacks, it is possible

to point out several general trends in the dietary patterns that contribute to the general aim of this volume 'Landscapes as Resource Assemblages in the Bronze Age of Southern Spain'. Therefore, the following cultural assessments must be considered as a first approach.

Isotopic data in agreement with the archaeological record reveals subsistence strategies in both megalithic and Argaric populations based on a mixed economy comprised of herding and farming, without aquatic resources (marine and freshwater) being routinely exploited. Studies of faunal and plant remains reveal that food resources came from domestic sheep, goats, cattle and pigs for meat and dairy products, and cereals such as barley and wheat and, to a lesser extent, legumes such as beans and peas. These resources comprise a baseline whose relevance in dietary patterns fluctuates over time and between contemporary settlements. Dietary information provided by bone collagen stable isotopes outlines a key aspect for a better understanding of this variability in subsistence strategies.

The dietary comparison of megalithic and Argaric societies reveals several remarkable issues. Megalithic societies show a rather homogeneous dietary pattern without significant inter-individual differences. Isotopic markers appear to be in agreement with a society based mainly on collective and relational identities that would have prevented the development of social asymmetries. This scenario changes for the Argaric population, as the isotopic composition shows an increase in animal-derived protein consumption, although it was unevenly distributed, with a higher inter-individual variability. Surprisingly, this asymmetrical access to high-quality foodstuffs such as meat and dairy products does not correlate with the social categories based on the individual grave goods. In fact, most of the attempts to link social categories and dietary pattern failed. Only in the case of La Bastida was some general positive correlation found among the individuals with the highest social status and the highest carbon and nitrogen isotopic values (Knipper et al. 2020).

While the variability in access to the more valued foodstuffs seems to be a feature of the Argaric period, the contemporary megalithic Bronze Age populations show a more conservative dietary pattern. The similar isotopic ratios of the Chalcolithic and Bronze Age populations at the El Barranquete megalithic cemetery also suggest a continuity in consumption habits. Particularly remarkable is the absence of isotopic values among the megalithic Bronze Age individuals comparable with those exhibited by the Argaric elites found at sites such as La Bastida. Although key aspects in feeding practices, such as where, when, why, by whom and under what circumstances specific foods were prepared and consumed, cannot be discerned from isotope analysis, it appears that cultural-based dietary differences between the megalithic and Argaric populations can be recognised as an important feature.

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Bibliography

- Ambrose 1993*: S. H. Ambrose, Isotopic Analysis of Paleodiets. Methodological and Interpretive Considerations. In: M. K. Sandford (ed.), *Investigations of Ancient Human Tissue. Chemical Analyses in Anthropology* (Langhorne 1993) 59–130.
- Anderson et al. 2011*: R. S. Anderson/G. Jiménez-Moreno/J. S. Carrión/C. Pérez-Martínez, Postglacial History of Alpine Vegetation, Fire, and Climate from Laguna de Río Seco, Sierra Nevada, Southern Spain. *Quaternary Science Reviews* 30, 2011, 1615–1629.
- Aranda Jiménez 2015*: G. Aranda Jiménez, Resistencia e involución social en las comunidades de la Edad del Bronce del sureste de la Península Ibérica. *Trabajos de Prehistoria* 72.1, 2015, 126–144.
- Aranda Jiménez/Lozano Medina 2014*: G. Aranda Jiménez/A. Lozano Medina, The Chronology of Megalithic Funerary Practices. A Bayesian Approach to Grave 11 at El Barranquete Necropolis (Almería, Spain). *Journal of Archaeological Science* 50, 2014, 369–382.
- Aranda Jiménez et al. 2015*: G. Aranda Jiménez/S. Montón-Subías/M. Sánchez Romero, The Archaeology of Bronze Age Iberia. *Argaric Societies* (New York 2015).
- Aranda Jiménez et al. 2017*: G. Aranda Jiménez/A. Lozano Medina/M. D. Camalich Massieu/D. Martín Socas/F. J. Rodríguez Santos/A. Trujillo Mederos/J. Santana Cabrera/A. Nonza-Micaellie/X. Clop García, La cronología radiocarbónica de las primeras manifestaciones megalíticas en el sureste de la Península Ibérica. Las necrópolis de Las Churuletas, La Atalaya y Llano del Jautón (Purchena, Almería). *Trabajos de Prehistoria* 74.2, 2017, 257–277.
- Aranda Jiménez et al. 2018a*: G. Aranda Jiménez/A. Lozano Medina/M. Díaz-Zorita Bonilla/M. Sánchez Romero/J. Escudero Carrillo, Cultural Continuity and Social Resistance. The Chronology of Megalithic Funerary Practices in Southern Iberia. *European Journal of Archaeology* 21.2, 2018, 192–216.
- Aranda Jiménez et al. 2018b*: G. Aranda Jiménez/A. Lozano Medina/M. Sánchez Romero/M. Díaz-Zorita Bonilla/H. Bocherens, The Chronology of the Megalithic Funerary Practices in South-Eastern Iberia. The Necropolis of Panoría (Granada, Spain). *Radiocarbon* 60.1, 2018, 1–19.
- Aranda Jiménez et al. 2020a*: G. Aranda Jiménez/M. Díaz-Zorita Bonilla/D. Hamilton/L. Milesi/M. Sánchez Romero, The Radiocarbon Chronology and Temporality of the Megalithic Cemetery of Los Millares (Almería, Spain). *Archaeological and Anthropological Sciences* 12, 2020, 104.
- Aranda Jiménez et al. 2020b*: G. Aranda Jiménez/M. Sánchez Romero/M. Díaz-Zorita Bonilla/A. Lozano Medina/J. Escudero Carrillo/L. Milesi García, Cultural Resistance to Social Fragmentation. The Continuity and Reuse of Megalithic Monuments during the Argaric Bronze Age in Southeastern Iberia. In: P. Díaz-del-Río/K. Lillos/I. Sastre (eds.), *The Matter of Prehistory. Papers in Honor of Antonio Gilman Guillén*. *Bibliotheca Praehistorica Hispana XXXVI*. Consejo Superior de Investigaciones Científicas (Madrid) 211–231.
- Aranda Jiménez et al. 2021*: G. Aranda Jiménez/M. D. Cálalich Massieu/D. Martín Socas/M. Díaz-Zorita Bonilla/D. Hamilton/L. Milesi García, New Insights into the Radiocarbon Chronology of Iberian Megalithic Societies. The Tholos-Type Tombs of Mojácar (Almería, Spain). *European Journal of Archaeology* 24.1, 2021, 4–26.
- Bartelheim 2012*: M. Bartelheim, Detecting Social Structures in the Bronze Age of Southeastern Spain. In: T. L. Kienlin/A. Zimmermann (eds.), *Beyond Elites. Alternatives to Hierarchical Systems in Modelling Social Formations* (Bonn 2012) 339–354.
- Cámara Serrano/Molina González 2011*: J. A. Cámara Serrano/F. Molina González, Jerarquización social en el mundo agárico (2000–1300 aC). *Quaderns de Prehistoria i Arqueologia de Castellò* 29, 2011, 77–104.
- Carrión et al. 2003*: J. S. Carrión/P. Sánchez-Gómez/J. F. Mota/R. Yll/C. Chaín, Holocene Vegetation Dynamics, Fire and Grazing in the Sierra de Gádor, Southern Spain. *The Holocene* 13.6, 2003, 839–849.

- Carrión et al. 2004*: J. S. Carrión/E. I. Yll/K. J. Willis/P. Sánchez-Gómez, Holocene Forest History of the Eastern Plateaux in the Segura Mountains (Murcia, Southeastern Spain). *Review of Palaeobotany and Palynology* 132.3–4, 2004, 219–236.
- Carrión et al. 2007*: J. S. Carrión/N. Fuentes/P. González-Sampériz/L. Sánchez Quirante/J. C. Finlayson/S. Fernández/A. Andrade, Holocene Environmental Change in a Montane Region of Southern Europe with a Long History of Human Settlement. *Quaternary Science Reviews* 26.11, 2007, 1455–1475.
- Chapman 2008*: R. Chapman, Producing Inequalities. Regional Sequences in Later Prehistoric Southern Spain. *Journal of World Prehistory* 21, 2008, 195–260.
- Díaz-Zorita Bonilla et al. 2019*: M. Díaz-Zorita Bonilla/G. Aranda Jiménez/H. Bocherens/J. Escudero Carrillo/M. Sánchez Romero/A. Lozano Medina/E. Alarcón García/L. Milesi García, Multi-Isotopic Diet Analysis of South-Eastern Iberian Megalithic Populations. The Cemeteries of El Barranquete and Panoría. *Archaeological and Anthropological Science* 11.2, 2019, 3681–3698.
- Díaz-Zorita Bonilla et al. 2020*: M. Díaz-Zorita Bonilla/J. Beck/G. Aranda Jiménez/L. Milesi García/M. Sánchez Romero/A. Lozano Medina/J. Escudero Carrillo/C. Knipper, The Deposition of Human Remains Inside Chalcolithic Ditched Enclosures. Ditch 5 at Marroquíes (Jaén, Spain). *European Journal of Archaeology* 23.3, 2020, 330–355.
- Froehle et al. 2012*: A. W. Froehle/C. M. Kellner/M. Schoeninger, Multivariate Carbon and Nitrogen Stable Isotope Model for the Reconstruction of Prehistoric Human Diet. *American Journal of Physical Anthropology* 147.3, 2021, 352–369.
- Gilman 2001*: A. Gilman, Assessing Political Development in Copper and Bronze Age Southeast Spain. In: J. Hass (ed.), *From Leaders to Rulers* (New York 2001) 59–84.
- Gilman 2013*: A. Gilman, Were There States during Later Prehistory of Southeastern Iberia? In: M. Cruz Berrocal/L. García Sanjuán/A. Gilman (eds.), *The Prehistory of Iberia. Debating Early Social Stratification and the State* (New York 2013) 10–28.
- Knipper et al. 2020*: C. Knipper/C. Rihuete-Herrada/J. Voltas/P. Held/V. Lull/R. Micó/R. Risch/K. W. Alt, Reconstructing Bronze Age Diets and Farming Strategies at the Early Bronze Age Sites of La Bastida and Gatas (Southeast Iberia) Using Stable Isotope Analysis. *PLoS ONE* 15.3, 2020, e0229398.
- Lozano Medina/Aranda Jiménez 2017*: A. Lozano Medina/G. Aranda Jiménez, La temporalidad de las sepulturas megalíticas tipo Tholos del sur de la Península Ibérica. *Spal. Revista de Prehistoria y Arqueología* 26, 2017, 17–31.
- Lozano Medina/Aranda Jiménez 2018*: A. Lozano Medina/G. Aranda Jiménez, Long-Lasting Sacred Landscapes. The Numerical Chronology of the Megalithic Phenomenon in South-Eastern Iberia. *Journal of Archaeological Science. Reports* 19, 2018, 224–238.
- Lull/Risch 1995*: V. Lull/R. Risch, El estado argarico. *Verdolay* 7, 1995, 97–109.
- Lull et al. 2009*: V. Lull/R. Micó/R. Risch/C. Rihuete, El Argar. La formación de una sociedad de clases. In: M. Hernández Pérez/J. A. Soler Díaz/J. A. López Padilla (eds.), *En los confines del Argar. Una cultura de la Edad del Bronce en Alicante* (Alicante 2009) 224–245.
- Lull et al. 2011*: V. Lull/R. Micó/C. Rihuete Herrada/R. Risch, The Argar and the Beginning of Class Society in the Western Mediterranean. In: S. Hansen/J. Müller (eds.), *Sozialarchäologische Perspektiven. Gesellschaftlicher Wandel 5000–1500 v. Chr. zwischen Atlantik und Kaukasus* (Berlin 2011) 381–414.
- Lull et al. 2013*: V. Lull/R. Micó/C. Rihuete Herrada/R. Risch, Bronze Age Iberia. In: H. Fokkens/A. Harding (eds.), *The Oxford Handbook of European Bronze Age* (Oxford 2013) 594–616.

- Molina González et al. 2016*: F. Molina González/J. A. Cámara Serrano/A. Delgado Huertas/S. A. Jiménez Brobeil/T. Nájera Colino/J. A. Riquelme Cantal/L. Spanedda, Problemas cronológicos y análisis de dieta en la Edad del Bronce de los Altiplanos granadinos. El caso del Cerro de la Virgen (Orce, Granada, España). Del neolítico a l'edat del bronze en el Mediterrani occidental. *Estudis en homenatge a Bernat Martí Oliver*. *Tabajos Varios SIP* 119, 2016, 451–463.
- Molina González et al. 2019*: F. Molina González/F. Nocete/A. Delgado Huertas/J. A. Cámara Serrano/R. M. Martínez Sánchez/S. A. Jiménez-Brobeil/M. T. Miranda/J. A. Riquelme Cantal/L. Spanedda/C. Pérez-Bareas/R. Lizcano Prestel/J. M. Nieto Liñan/T. Nájera Colino/A. Granados-Torres/F. Carrión Mendez, Diet and Environment in South-Eastern Iberia during the Bronze Age, Based on Isotope Analysis of Human Remains. *Oxford Journal of Archaeology* 38.2, 2019, 189–213.
- Nehlich 2015*: O. Nehlich, The Application of Sulphur Isotope Analyses in Archaeological Research. A Review. *Earth-Science Review* 142, 2015, 1–17.
- Pantaleón-Cano et al. 2003*: J. Pantaleón-Cano/E. I. Yll/R. Pérez-Obiol/J. M. Roure, Palynological Evidence for Vegetational History in Semi-Arid Areas of the Western Mediterranean (Almería, Spain). *The Holocene* 13.1, 2003, 109–119.
- Peters/von den Driesch 1990*: J. Peters/A. von den Driesch, Archäozoologische Untersuchung der Tierreste aus der Kupferzeitlichen Siedlung von Los Millares (Prov. Almeria). In: A. von den Driesch (ed.), *Neolithische und Kupferzeitliche Tierknochenfunde aus Südspanien. Studien über frühe Tierknochenfunde von der Iberischen Halbinsel* 12 (München 1990) 51–115.
- Ramos Millán 2013*: A. Ramos Millán, Villages of Wealth and Resistance in Paradise. Millarian and Argaric Chiefdoms in the Iberian Southeast. In: M. Cruz Berrocal/L. García Sanjuán/A. Gilman (eds.), *The Prehistory of Iberia. Debating Early Social Stratification and the State* (New York 2013) 74–98.
- Rodríguez-Ariza 2000*: O. Rodríguez-Ariza, El paisaje vegetal de la depresión de Vera durante la Prehistoria Reciente. Una aproximación desde la antracología. *Trabajos de Prehistoria* 57.1, 2000, 145–156.
- Rodríguez-Ariza et al. 1996*: O. Rodríguez-Ariza/V. Ruiz/R. Buxó/M. T. Ros, Paleobotany of the Bronze Age Community, Castellón Alto (Galera, Granada, Spain). *Actes du colloque d'Archéométrie de Perigueux 1995. Revue d'Archéométrie. Supplément* 1996, 191–196.
- Schirrmacher et al. 2020*: J. Schirrmacher/J. Kneisel/D. Knitter/W. Hamer/M. Hinz/R. R. Schneider/M. Weinelt, Spatial Patterns of Temperature, Precipitation, and Settlement Dynamics on the Iberian Peninsula during the Chalcolithic and the Bronze Age. *Quaternary Science Reviews* 233, 2020, 106–220.
- Schoeninger/DeNiro 1984*: M. J. Schoeninger/M. J. DeNiro, Nitrogen and Carbon Isotopic Composition of Bone Collagen from Marine and Terrestrial Animals. *Geochimica et Cosmochimica Acta* 48, 1984, 625–639.
- Schoeninger et al. 1983*: M. J. Schoeninger/M. J. DeNiro/H. Tauber, Stable Nitrogen Isotope Ratios of Bone Collagen Reflect Marine and Terrestrial Components of Prehistoric Human Diet. *Science* 220, 1983, 1381–1383.
- Waterman et al. 2017*: A. J. Waterman/J. L. Beck/J. T. Thomas/R. H. Tykot, Stable Isotope Analysis of Human Remains from Los Millares Cemetery (Almería, Spain, c. 3200–2200 cal BC). Regional Comparisons and Dietary Variability. *Menga. Revista de Prehistoria de Andalucía* 8, 2017, 15–27.

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Second Millennium BC Plant Resources in Southern Iberia

Reconstructing Subsistence Practices

Keywords: archaeobotany, agriculture, wild plants, 2nd mill. BC, Andalucía

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Abstract

Plant resources represent one of the least studied topics in Iberian prehistory despite their potential not only to reconstruct patterns of plant exploitation, but also to understand subsistence practices, and to improve our knowledge of plant use among human communities in the past. In this paper we present the archaeobotanical data (seeds and fruits) available for the south of the Iberian Peninsula during the 2nd mill. BC. We use data already published by different colleagues including one of the authors. The focus is put on the diversity of species cultivated during this period, as well as on the exploitation of wild plants for food and other uses, trying to provide an accurate picture of Bronze Age plant subsistence in the area. Different crops such as barley and wheat (mainly free-threshing species) and several legumes have been identified while a wide diversity of wild resources is also observed. Flax and poppy were likewise cultivated in the area. Although the number of sites studied is still limited, results suggest that plants were an important resource for the Bronze Age communities.

Introduction

Over the past few decades, a number of Bronze Age excavations in Andalucía have included the systematic sampling and recovery of plant remains which have produced an interesting corpus of archaeobotanical data. Plant remains were, however, known to archaeology since the late 19th cent. AD, particularly from the work of the famous Siret brothers (Siret/Siret 1890), two mining engineers who through their work in the southeastern part of Andalucía discovered extraordinary archaeological sites and burials characterised by their extreme richness and spanning the Chalcolithic and the Bronze Age. Among the archaeological material there were also seeds and other plant remains that were drawn and recorded using the species common names. However, no indications were given about their taxonomic classification (Peña-Chocarro/Pérez-Jordà 2018; Rovira 2007). Our knowledge of the plants used by these communities during the Bronze Age was later enlarged by the work of other researchers such as Netolitzky (1935), and Téllez and Ciferri (1954), who dealt with the plant assemblages available at that time. From the 60s the influential Maria Hopf started the systematic study of archaeobotanical samples from a variety of sites and regions in Spain, including Bronze Age sites in Andalucía such as Cerro de La Virgen (Hopf 1991). Knowledge has been further increased by the work of Buxó (1997), Stika (1988; 1998; 2000; 2001; Stika/Heiss in press; Stika/Jurich 1998; Stika et al. 2017a; 2017b), Peña-Chocarro (1999), Rovira (2007), and



Fig. 1. Bronze Age sites with archaeobotanical studies in Andalucía mentioned in the text. 1. Cueva de El Toro, 2. Los Castillejos de Montefrío, 3. El Berral, 4. Los Alcores, 5. Peñalosa, 6. Cerro del Alcázar, 7. Eras del Alcázar, 8. Cuesta del Negro, 9. Guadix, 10. Castellón Alto, 11. Fuente Amarga, 12. Cerro de la Virgen, 13. Fuente Álamo, 14. El Argar, 15. Gatas.

more recently by that of Montes Moya (2014). In the context of this growth of archaeobotanical research, it is now possible to present an overview of plant resources during the Bronze Age in the region. Nonetheless, there are still many blank areas, gaps in the datasets and issues to be resolved.

In this paper currently published archaeobotanical data (seeds and fruits) focusing on the 2nd mill. BC are presented. It attempts to investigate the range of plant resources, cultivated and wild, available to Bronze Age communities, their role in subsistence, exploring issues of diversity and choice. Bearing in mind that data from several sites will be presented and discussed, the text is fundamentally descriptive.

Most of the material presented in this chapter has been preserved by charring, and some by mineralisation. There is no evidence whatsoever of waterlogged material from the Bronze Age in the region. Apart from the samples collected by

the Siret Brothers at the end of the 19th cent. AD and some hand-picked samples from the 1960s and 70s, most of the material considered for this study comes from systematic sampling and flotation. A total of 15 sites (*fig. 1*) located in the east of Andalucía (provinces of Málaga, Jaén, Granada and Almería) has been considered. Unfortunately, there is no information coming from the western part of the region.

The Plant Remains

Differently from other periods, such as the Neolithic or the Iron Age, when new plant introductions resulted in changes in subsistence, the Bronze Age in Andalucía is a rather homogeneous period in terms of plant use. Archaeobotanical evidence from the preceding Chalcolithic suggests the practice of a well-developed agriculture based on the cultivation of cereals (hulled and naked species



Fig. 2. Seeds and fruits present in the sites studied. 1. *Hordeum vulgare* var. *nudum*, 2. *Triticum aestivum/durum/turgidum*, 3. *Hordeum vulgare* subsp. *vulgare*, 4. *Triticum dicoccum*, 5. *Vicia faba*, 6. *Triticum monococcum*, 7. *Pisum sativum*, 8. *Vitis vinifera*, 9. *Olea europaea*, 10. *Linum usitatissimum*. Scale 1mm.

and varieties of wheat and barley), legumes (broad bean, lentil, pea, grass pea, bitter vetch, and several other species of the genus *Vicia*) and oil/textile crops (flax and poppy). This combination of species seems to have continued during the Bronze Age (table 1 and fig. 2) when direct evidence of agricultural production is more abundant and of better quality. Fruits are mostly represented by figs, olives, grapes and acorns. There is also a wide variety of wild species that have been interpreted as weeds, or plants representing the local vegetation.

The Cereals

From the total number of domesticated species recorded at the selected sites, the cereals are by far the most abundant category, indicating their leading role in Bronze Age subsistence as suppliers of the main source of carbohydrates.

The two major species are the free-threshing, or naked wheats (*Triticum aestivum/durum/turgidum*) and barley, both hulled (*Hordeum vulgare* subsp. *vulgare*) and naked (*Hordeum vulgare* var. *nudum*).

Site	Cerro Virgen	El Berral	Eras del Alcazar	Los Alcores	El Argar	Gatas	Castellón Alto
Reference	Buxó 1993	Stika et al. 2017a; b	Montes Moya 2014	Stika et al. 2017a; b	Stika/Jurich 1998	Stika 2003	Rovira 2007
Cereals							
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>	x		x	x	x	xx	xxx
<i>H. vulgare</i> var <i>nudum</i>	xxx	x	xx	x	x		x
<i>Triticum aestivum/durum</i>	xxxx		xxx	x	x	x	xxx
<i>Triticum monococcum</i>		x	x	x			x
<i>Triticum dicoccum</i>	x		xx	x	x		
cf. <i>Panicum miliaceum</i>							x
<i>Panicum/Setaria</i>							
Legumes							
<i>Lathyrus sativus/cicera</i>			x				
<i>Lens culinaris</i>							
<i>Pisum sativum</i>			x				x
<i>Vicia ervilia</i>			x				x
<i>V. faba</i>	x	x	xx	x			x
Oil plants							
<i>Linum usitatissimum</i>			x	x	x		xx
<i>Papaver somniferum</i>			x	x			x
Wild Fruits							
<i>Capparis spinosa</i>							x
<i>Corylus avellana</i>							x
<i>Ficus carica</i>				x	x	x	x
<i>Myrtus communis</i>							
<i>Olea europaea</i>					x		x
<i>Pinus halepensis</i>							x
<i>Pinus</i> sp.							x
<i>Pyrus</i> sp.							
<i>Quercus</i> sp.	x						x
<i>Rubus fruticosus</i>							x
<i>Rubus idaeus</i>							x
<i>Vitis vinifera</i>							x

Table 1. List of the main cultivated plants and edible fruits identified at the selected sites. X = 1–99 remains, XX = 100–999 remains, XXX = >1,000 remains.

Cuesta Negro	Fuente Amarga	Los Castillejos	Toro	Peñalosa	Fuente Álamo	Cerro del Alcázar	Guadix
Buxó 1993	Buxó 1993	Rovira 2007	Buxó 1993	Peña-Chocarro 1999	Stika 1988; 2001	Montes Moya 2014	Rovira 2007
x	x	x		xxx	x	xxx	x
	x	xx	x	xx	x	xxx	x
xxx	x	xx	xx	xx	x	xxx	x
x		xx		x	x	xxx	x
x					x		x
				x			
			x			x	
x	x		x				
		x	x	x	x	x	x
					x	x	x
		xx	x	x	x	x	
		x		x	xx	x	
					x		
					xxx		
x							
			x	x	x	x	
				x			
			x			x	
x	x			x	x	x	

It is evident from the archaeobotanical data that mixed assemblages of hulled and naked barley from the same site are quite common (table 1). There are sites where one or another dominates and others where only one of them has been identified.

Barley is an important crop which is quite resistant to environmental stress, particularly drought, and well adapted to low fertile soils. In all Early Bronze Age sites, except from El Argar (Stika/Jurich 1998), naked barley dominates over hulled barley, while from the middle Bronze Age, apart from Los Castillejos (Rovira 2007), the cereal assemblages are dominated by hulled barley. Archaeobotanical evidence suggests that in some European areas naked barley was replaced by the hulled type at some point during the Bronze Age (Stika/Heiss 2013). This of course did not occur at the same time in all areas, but the trend is also observed on the Iberian Peninsula. Reasons for switching to hulled barley include a variety of factors which may have been different at each area, from adaptation to climatic conditions to food choices.

As for the hulled wheats, einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*) are less common. In fact, while small quantities of einkorn are almost present in all sites at least during the Early Bronze Age (always in low numbers in comparison to other cereals), emmer appears less frequently in the sites studied. There are a few exceptions such as the surprising high numbers of einkorn found in Los Castillejos (Granada) during the Middle Bronze Age, where it occupies a dominant position together with the free threshing wheats. Other sites such as Cerro de la Virgen (Hopf 1991; Buxó 1997) and Castellón Alto (Rovira 2007), both in Granada province, and Los Alcores (Stika et al. 2017a; 2017b) and Cerro del Alcázar (Jaén) (Montes Moya 2014) have provided evidence of emmer and einkorn but in less quantities when compared to the above-mentioned sites. Both naked barley and hulled wheats were more abundant in the earlier phases and the general trend is to decrease as the millennium progresses.

While cereal grains are abundant, chaff appears less frequently, consisting mostly of rachis segments. There are some exceptions such as the case of Fuente Álamo (Stika 1998; 2000; 2001) and

Castellón Alto (Rovira 2007), where chaff remains from naked and hulled barley in considerable quantities have been found. In the case of wheat, rachis segments are less abundant, precluding the identification of the precise wheat species involved. In small quantities, cereal chaff is present at Los Alcores, Fuente Álamo, Castellón Alto and Peñalosa (Peña-Chocarro 1999). In some cases, it has been possible to identify two of the three naked wheat species grouped under the taxonomic classification of *T. aestivum/durum/turgidum* (naked or free-threshing wheats) which otherwise is impossible when only caryopses are preserved.

Free-threshing wheats together with hulled barley were, anyhow, the commonest species in the region and surrounding areas and they represent the main components of food.

As for the millets, and focusing in Andalucía during the Bronze Age, the situation is unclear and the topic deserves some discussion. The only possible 2nd mill. BC millets (either *Panicum miliaceum* or *Setaria italica*) are those from Peñalosa (Peña-Chocarro 1999), while the remaining millets from the region, those from Guadix (Rovira 2007) and from Huelva (Pérez-Jordà et al. 2017), come from the early 1st mill. BC, when communities from the eastern Mediterranean were already established in the Andalusian coast (at least, this is the case of Huelva). These communities were responsible for the introduction of new crops like some fruit trees, that is cultivated grape and olive, almond and pomegranate and possibly other crops such as the millets. In the Iberian Peninsula, the history of millets starts during the 2nd mill. BC. Early finds have been found at Cova de Punta Farisa (Alonso/Buxó 1995) and Masada del Ratón (Alonso 1999) in Huesca, El Vilot in Lleida (Alonso et al. 2002), and in Portugal (Tereso et al. 2016; Jesus et al. 2020). Later on, during the 1st mill. BC, millets spread along the Mediterranean coast and the northwest of the Iberian Peninsula. The limited data precludes discussing when and how the introduction and spread of these crops took place and whether there were one or different routes of arrival into the Iberian Peninsula.

Many hypotheses have been provided to explain the introduction of millets in the agricultural system. Millets have a very short life-cycle that allows the plant maturing rather fast. This

fast-growing capacity can provide an alternative harvest in bad years, reducing the risk of bad crop yields. In addition, millets are drought-tolerant and could have been cultivated in small plots at places where wheat may have found difficulties to thrive. Moreover, millets produce high yields that can be stored. Their grains are not only easy to process, but they can also be prepared into meals in different ways. Their incipient introduction into the agricultural system of the Iberian Peninsula represents a clear novelty that will be fully established during the 1st mill. BC and accompanied by other innovations in technology, agricultural practices and a larger variety of crops. For Greece, Valamoti (2016) suggests that the introduction of millet during the Bronze Age may have been linked to the establishment of new ways of cooking.

Summarising, for Andalucía data is still limited, suggesting that millets were not widespread during the 2nd mill. BC, while wheat and barley were the main cereal species consumed by the Bronze Age communities.

The Legumes

Despite the fact that legumes probably played an important role for the food economy of prehistoric communities, the archaeobotanical evidence is scarce. Several species have been identified showing the diversity of pulses available during the 2nd mill. in Andalucía: lentil (*Lens culinaris*), pea (*Pisum sativum*), broad bean (*Vicia faba*), vetch (*Vicia sativa*), bitter vetch (*Vicia ervilia*) and grass pea (*Lathyrus sativus/cicera*). The number of specimens in each site is modest and, in general, the number of remains of each species does not exceed 20 seeds. The exception is represented by the pea and the broad bean which have been found in larger amounts in several sites. This is the case of Eras del Alcázar and Cerro del Alcázar (Jaén) where a concentration of broad beans (almost 1000 seeds in Eras del Alcázar) and peas were identified during the Early Bronze Age. From Middle Bronze Age Castellón Alto a small concentration of peas was also retrieved, while at Los Castillejos broad beans also appeared in large numbers. A smaller quantity of broad beans is also present at Cueva del Toro (Buxó 1997).

A recent study (Tarongi Chávarri et al. 2020) focusing on the Bronze and Iron Ages in eastern Iberia (including some of the sites considered in this paper) discusses the low representativeness of pulses in the archaeological record and indicates some possible explanations. The secondary role of legumes in agriculture, if compared to cereals, may determine the lower presence of pulses in the archaeological record. Moreover, many species were consumed in the form of green pods which have a much lower probability of getting charred and therefore being preserved. Finally, high charring temperatures seem to be less tolerated by legumes in comparison to cereals.

Despite their lower representativeness in the archaeobotanical record, pulses played a significant role in human diet as they are an important source of proteins. Moreover, they contribute to restore soil fertility. Ethnographic data (Jones 1992; Peña-Chocarro/Zapata 1999; Reddy 2006; Sarpaki/Jones 1990; Valamoti et al. 2011) suggests that legumes could be consumed either green (pods and seeds) or dry (seeds) and once processed they can be cooked, roasted, boiled or baked. They could be eaten in combination with other pulses, cereals, or other plants. Some of them need detoxification prior to human consumption, an operation that implies the leaching of toxins through soaking.

The archaeobotanical record of legumes in Andalucía is limited but provides interesting insights into the wide variety of species used during the period studied.

Consumption of Fruits

Bronze Age sites in Andalucía have also provided information on the consumption of wild fruits. The number of remains is limited, but at least figs, olives, grapes, hazelnuts, acorns, pine nuts, blackberries, raspberries, myrtle, pears, cappers and mastic seeds have been identified at several sites (Alonso et al. 2016). Figs appear represented in half of the sites under study, with high concentrations in Fuente Álamo, where fig seeds were preserved both charred and mineralised. The mineralised seeds have been interpreted as faecal material (Stika 1988; 2000; 2001; Stika/Heiss in press). Wild olives and grapes are less common

throughout the sites studied, while the remaining species only appear occasionally. Despite the lack of clear evidence of olive cultivation during this period and the fact that fruits were probably used from wild plants, recent research (Celma Martínez/Stika 2020) suggests that olive together with grapes and figs may have been circulating between sites within exchange networks.

It is likely that the variety and number of consumed fruits was much greater as it is demonstrated by the plant record from waterlogged contexts, a type of environment that favours the preservation of fruit remains and provides evidence of a much larger diversity (Peña-Chocarro et al. 2014; Sabato et al. 2015).

The wild species identified were most probably gathered in the surroundings of the sites; some could be dried and stored while others could be directly consumed. They contributed to diversify human plant diet and probably were a significant food resource in case of bad harvests.

Oil and Textile Plants

Two oil plants, flax and poppy, are well documented in the archaeobotanical record of Andalucía during the 2nd mill. BC. Flax (*Linum usitatissimum*) appears in most of the sites considered for this paper. Seeds and capsule fragments are represented. In Fuente Álamo and Castellón Alto the number of seeds exceeds one hundred, while in the remaining sites the quantity of seeds is much lower. Flax is well represented in the area at least since the Chalcolithic and during the Bronze Age its presence is much more homogeneous (Rovira 2007). Flax is a multi-use crop that has been traditionally grown for its fibres for textile production and their seeds used for oil production or dietary and medicinal purposes. Although the available data does not allow exploring the possible uses of this species, it is clear that flax was widespread during the 2nd mill. BC in Andalucía.

The second oil crop is poppy (*Papaver somniferum*), which has only been found in very small numbers at Eras del Alcázar, Los Alcores and Fuente Álamo in Early Bronze Age levels. Although poppy is well documented in the region since the Neolithic (Buxó 1997; Neuweiler 1935;

Peña-Chocarro 1999; Rovira 2007), representing a characteristic trait of the area, during the Bronze Age the presence of poppy is very modest. One of the problems encountered when dealing with this species relates to the difficulties to distinguish the wild *P. somniferum* ssp. *setigerum* from the cultivated *P. somniferum* ssp. *somniferum* (Hammer/Fritsch 1977), precluding a precise taxonomical classification. From the data available, only the poppy capsules retrieved from the Cueva de Los Murciélagos (Albuñol, Granada) have been identified as wild poppy specimens (Neuweiler 1935).

The Wild Species

In many areas, there were also wild plants abundant that could have been used for multiple purposes other than food. For instance, different plant parts (fruits, seeds, flowers, fibres, roots, rhizomes, bulbs, etc.) were most probably used for daily activities such as dyeing, flavouring, healing, heating, crafting, insect repelling or ritual practices among others. In fact, the archaeobotanical record has provided plenty of evidence of the use of wild plants since pre-agrarian times for different purposes (Antolín et al. 2016; Antolín/Jacomé 2015; Colledge/Conolly 2014; Morales 2018). From the Neolithic onwards, the presence of wild species, particularly weeds, has been often related to the practice of agriculture. Thus, many wild species found in agricultural sites have been interpreted as noxious weeds.

Apart from four sites (Los Alcores, Fuente Álamo, Castellón Alto and Peñalosa) out of the 16 selected where wild plant remains were abundant, the remaining sites only yielded a few wild specimens. The list of species is large and includes members of different families. Those providing larger quantities of remains are the Poaceae (*Eragrostis* sp., *Bromus* sp., wild *Hordeum*, different species of *Lolium*, *Stipa tenacissima*), Fabaceae (*Trifolium* sp., *Trigonella* sp., *Retama* sp.), Malvaceae (*Malva* sp.), Rubiaceae (*Galium* sp.), Chenopodiaceae (*Chenopodium* sp.), Cistaceae (*Cistus* sp.), Labiatae (*Lavandula* sp., *Rosmarinus officinalis*) amongst many others. Many of the species identified correspond to agricultural weeds but some may also represent species growing in

wasteland areas. In fact, at Peñalosa, some samples have been interpreted as resulting from sieving activities during crop processing, which were intended to separate the grain from its contaminants (chaff, weed seeds, etc.). Others are clear representatives of the Mediterranean vegetation that characterised the region such as the *Retama sphaerocarpa*, which grows in shrublands produced by the degradation of oak and pine forests, or the various specimens of *Cistus* sp. (seeds and leaves), a typical shrub of the Mediterranean area. Of particular interest is the presence of a high concentration of lavender seeds at the site of Peñalosa. Lavender appears in almost every structure of the site, being probably related to its aromatic properties.

Concluding Remarks

The study of plant macro-remains can provide insights into plant subsistence, and more generally into plant use. Although it is clear that a significant part of the original plant remains used by prehistoric communities did not get preserved due to multiple factors (taphonomy, preservation, recovery, identification issues, etc.), seeds and fruits are still excellent ways to approach plant subsistence.

Bronze Age agriculture appears well established across the region, although there are still large areas from where archaeobotanical data is absent, particularly from the western part (Huelva, Cádiz and Sevilla). There are also problems related to the chronological definition of high quality archaeobotanical assemblages such as that of Castellón Alto, or Cerro de la Virgen, but in general some overall trends can be pointed out.

The 2nd mill. BC did neither entail any change in the agricultural system nor the introduction of new crops in Andalucía. Continuity is seen in the variety of crops cultivated, although some, such as the cereals, may have played a different role within the economy of each site. Perhaps, the clearest example of change is the replacement of naked barley by the hulled form and the decline of the hulled wheats over time. However, recent research based on isotopic analyses hypothesises a likely reduction of cereal productivity at the end of the Argaric period, leading to a subsistence crisis which eventually caused the collapse of El Argar

culture (Knipper et al. 2020), but this hypothesis needs further research.

Other issues such as the possible regional differentiation between the coast of Almería, where barley predominated, and the interior of the Guadalquivir valley, where naked wheat was the main cereal, need to be explored in the future. Environmental factors may perhaps explain this difference.

Finally, there is no clear evidence in order to defend the existence of a local process of development of fruit growing, until the beginning of the new millennium.

In short, the archaeobotanical record stresses the continuity of the agricultural model implemented since the arrival of the first agricultural communities in this territory and suggests no major changes. The emergence of a complex society seems to be based in a similar agricultural system which maintained the previous variety of crops. Social relations, the economic organisation, strategies of food exploitation surely changed, but this did not affect the variety of crops cultivated. This system broke down at the turn of the millennium when contacts with communities from the eastern Mediterranean took place. Despite the contacts with eastern Mediterranean groups already during the 2nd mill. BC, they do not seem to have involved the introduction of new crops or novel agricultural techniques in Andalucía.

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Bibliography

- Alonso 1999*: N. Alonso, De la llavor a la farina. Els processos agrícoles protohistòrics a la Catalunya occidental (Lattes 1999).
- Alonso/Buxó 1995*: N. Alonso/R. Buxó, Agricultura, alimentación y entorno vegetal en la Cova de Punta Farisa (Fraga, Huesca) durante el Bronce Medio. *Quaderns del Departament de Geografia i Història* 24, 1995, 1–100.
- Alonso et al. 2002*: N. Alonso/M. Bergadà/M. Gené/X. Gómez/J. Juan/E. Junyent/Á. Lafuente/J. López-Melción/C. Mazo/A. Moya i Garra/J. Nadal/R. Piqué/S. Riera/E. Tartera, Recuperant el passat a la línia del Tren d'Alta Velocitat. L'assentament protohistòric, medieval i d'època moderna de El Vilot de Montagut (Alcarràs, Lleida) (Lleida 2002).
- Alonso et al. 2016*: N. Alonso/G. Pérez Jordà/N. Rovira/D. López Reyes, Gathering and Consumption of Wild Fruits in the East of the Iberian Peninsula from the 3rd to the 1st Millennium BC. *Quaternary International* 404, 2016, 69–85.
- Antolín et al. 2016*: F. Antolín/M. Berihuete/O. López, Archaeobotany of Wild plant Use. Approaches to the Exploitation of Wild Plant Resources in the Past and Its Social Implications. *Quaternary International* 404, 2016, 1–3.
- Antolín/Jacomet 2015*: F. Antolín/S. Jacomet, Wild Fruit Use Among Early Farmers in the Neolithic (5400–2300 cal bc) in the North-East of the Iberian Peninsula. An Intensive Practice? *Vegetation History and Archaeobotany* 24, 2015, 19–33.
- Buxó 1993*: R. Buxó, Des semences et des fruits. Cueillette et agriculture en France et en Espagne Méditerranéennes du Néolithique à l'Âge du Fer (PhD-Thesis Université de Montpellier 1993).
- Buxó 1997*: R. Buxó, Arqueología de las plantas. La explotación económica de las semillas y los frutos en el marco mediterráneo de Península Ibérica (Barcelona 1997).
- Celma Martínez/Stika 2020*: M. Celma Martínez/H.-P. Stika, Circulation of Olives, Figs and Grapes in the Area of El Argar Culture in South-Eastern Spain. *Journal of Archaeological Science. Reports* 31, 2020, 102366.
- Colledge/Conolly 2014*: S. Colledge/J. Conolly, Wild Plant Use in European Neolithic Subsistence Economies. A Formal Assessment of Preservation Bias in Archaeobotanical Assemblages and the Implications for Understanding Changes in Plant Diet Breadth. *Quaternary Science Reviews* 101, 2014, 193–206.
- Hammer/Fritsch 1977*: K. Hammer/R. Fritsch, Zur Frage nach der Ursprungsart des Kulturmoths (*Papaver somniferum* L.). *Die Kulturpflanze* 25, 1977, 113–124.
- Hopf 1991*: M. Hopf, Holzfunde vom Cerro de la Virgen, Orce (Granada). In: Festschrift für Wilhelm Schüle zum 60. Geburtstag. Veröffentlichung des Vorgeschichtlichen Seminars Marburg. Sonderband 6 = Internationale Archäologie 1 (Buch am Erlberg 1991) 173–176.
- Jesus et al. 2020*: A. Jesus/J. P. Tereso/R. Gaspar, Interpretative Trajectories towards the Understanding of Negative Features Using Terraço das Laranjeiras Bronze Age Site as a Case Study. *Journal of Archaeological Science, Reports* 30, 2020, 102222.
- Jones 1992*: G. E. M. Jones, Ancient and modern cultivation of *Lathyrus ochrus* (L.) DC. in the Greek Islands. *Annual of the British School at Athens* 87, 1992, 211–217.
- Knipper et al. 2020*: C. Knipper/C. Rihuete Herrada/J. Voltas/P. Held/V. Lull/R. Micó/R. Risch/K. Alt, Reconstructing Bronze Age Diets and Farming Strategies at the Early Bronze Age Sites of La Bastida and Gatas (Southeast Iberia) Using Stable Isotope Analysis. *PLoS ONE* 15.3, 2020, e0229398.
- Montes Moya 2014*: E. M. Montes Moya, Las prácticas agrícolas en la Alta Andalucía a través de los análisis carpológicos. Desde la Prehistoria Reciente al siglo II d.n.e (PhD-Thesis Universidad de Jaén 2014).

- Morales 2018*: J. Morales, The Contribution of Botanical Macro-Remains to the Study of Wild Plant Consumption during the Later Stone Age and the Neolithic of North-Western Africa. *Journal of Archaeological Science. Reports* 22, 2018, 401–412.
- Netolitzky 1935*: F. Netolitzky, Kulturpflanzen und Holzreste aus dem Prähistorischen Spanien und Portugal. *Buletinul Facultatii de Științe din Cernăuți* 9, 1935, 4–8.
- Neuweiler 1935*: E. Neuweiler, Nachträge urgeschichtlicher Pflanzen. *Vierteljahrsschrift der Naturforschenden Gesellschaft Zürich* 80, 1935, 98–122.
- Peña-Chocarro 1999*: L. Peña-Chocarro, Prehistoric Agriculture in Southern Spain during the Neolithic and the Bronze Age. *The Application of Ethnographic Models* (Oxford 1999).
- Peña-Chocarro et al. 2014*: L. Peña-Chocarro/P. Alkain/M. Urteaga, Wild, Managed and Cultivated Plants in Northern Iberia. An Archaeobotanical Approach to Medieval Plant Exploitation in the Basque Country. *Post-Classical Archaeologies* 4, 2014, 139–156.
- Peña-Chocarro/Pérez-Jordà 2018*: L. Peña-Chocarro/G. Pérez Jordà, Los estudios carpológicos en la Península Ibérica. Un estado de la cuestión. *Pyrenae* 49, 2018, 7–45.
- Peña-Chocarro/Zapata 1999*: L. Peña-Chocarro/L. Zapata, History and Traditional Cultivation of *Lathyrus sativus* L. and *Lathyrus cicera* L. in the Iberian Peninsula. *Vegetation History and Archaeobotany* 8, 1999, 49–52.
- Pérez-Jordà et al. 2017*: G. Pérez Jordà/L. Peña-Chocarro/M. García Fernández/J. C. Vera Rodríguez, The Beginnings of Fruit Tree Cultivation in the Iberian Peninsula. Plant Remains from the City of Huelva (Southern Spain). *Vegetation History and Archaeobotany* 26, 2017, 527–538.
- Reddy 2006*: S. B. Reddy, Indigenous Technical Knowledge on Pulses Storage and Processing Practices in Andhra Pradesh. *Indian Journal of Traditional Knowledge* 5, 2006, 87–94.
- Rovira 2007*: N. Rovira, Agricultura y Gestión de los Recursos Vegetales en el Sureste de la Península Ibérica durante la Prehistoria Reciente (PhD-Thesis Universitat Pompeu Fabra Barcelona 2007).
- Sabato et al. 2015*: D. Sabato/A. Masi/C. Pepe/M. Ucchesu/L. Peña-Chocarro/A. Usai/G. Bacchetta, Archaeobotanical Analysis of a Bronze Age Well from Sardinia. A Wealth of Knowledge. *Plant Biosystems* 149, 2015, 205–215.
- Sarpaki/Jones 1990*: A. Sarpaki/G. Jones, Ancient and Modern Cultivation of *Lathyrus clymenum* L. in the Greek Islands. *The Annual of the British School of Archaeology at Athens* 85, 1990, 363–369.
- Siret/Siret 1890*: E. Siret/L. Siret, Las primeras edades del metal en el sudeste de España (Barcelona 1890).
- Stika 1988*: H.-P. Stika, Botanische Untersuchungen in der bronzezeitlichen Höhensiedlung Fuente Álamo. *Madrider Mitteilungen* 29, 1988, 21–76.
- Stika 1998*: H.-P. Stika, Landwirtschaft, Klima und Umwelt zur Bronzezeit im semiariden Becken von Vera, Prov. Almería, Südostspanien. In: B. Hänsel (ed.), *Man and Environment in European Bronze Age* (Kiel 1988) 111–115.
- Stika 2000*: H.-P. Stika, Resultados arqueobotánicos de la campaña de 1988 en Fuente Álamo. In: H. Schubart/V. Pingel/O. Arteaga (eds.), *Fuente Álamo. Las excavaciones arqueológicas 1977–1991 en el poblado de la Edad del Bronce* (Sevilla 2000) 183–221.
- Stika 2001*: H.-P. Stika, Archäobotanische Ergebnisse der Grabungskampagne 1988 in Fuente Álamo. In: H. Schubart/V. Pingel/O. Arteaga (eds.), *Fuente Álamo Teil 1. Die Grabungen von 1977 bis 1991 in einer bronzezeitlichen Höhensiedlung Andalusiens* (Mainz am Rhein 2001) 263–336.
- Stika 2003*: H.-P. Stika, Verkohlte Pflanzenreste aus der bronzezeitlichen Höhensiedlung Gatas, Turre, Almería (Unpublished Report 2003).

- Stika/Heiss 2013*: H.-P. Stika/A. Heiss, Plant Cultivation in the Bronze Age. In: H. Fokkens/A. Harding (eds.), *The Oxford Handbook of European Bronze Age* (Oxford 2013) 340–361.
- Stika/Heiss in press*: H.-P. Stika/A. Heiss, Archäobotanische Ergebnisse der Grabungskampagnen 1991 und 1996 in Fuente Álamo. *Madridrer Beiträge* (in press).
- Stika/Jurich 1998*: H.-P. Stika/B. Jurich, Pflanzenreste aus der Probegrabung 1991 im bronzezeitlichen Siedlungsplatz El Argar, Prov. Almería, Südostspanien. *Madridrer Mitteilungen* 39, 1998, 35–48.
- Stika et al. 2017a*: H.-P. Stika/A. Heiss/B. Jurich, Kupfer- und bronzezeitliche Pflanzenreste aus Porcuna, Prov. Jaén, in Andalusien. *Madridrer Mitteilungen* 58, 2017, 57–79.
- Stika et al. 2017b*: H.-P. Stika/M. Berihuete Azorín/I. Stoll/A. Heiss, Restos vegetales prehistóricos y romanos del área de Porcuna (Jaén, Andalucía). In: J. Fernández Eraso/J. A. Mujika Alustiza/A. Arrizabalaga Valbuena/M. García Díez (eds.), *Miscelánea en homenaje a Lydia Zapata Peña (1965–2015)* (Bilbao 2017) 246–268.
- Tarongi Chávarri et al. 2020*: M. Tarongi Chávarri/G. Prats/N. Alonso, The Storage of Pulses during the Bronze and Iron Ages in the East of the Iberian Peninsula. Examining the Archaeological Data through the Lens of Ethnography. *Journal of Archaeological Science. Reports* 30, 2020, 102174.
- Téllez/Ciferri 1954*: R. Téllez/F. Ciferri, *Trigos Arqueológicos de España* (Madrid 1954).
- Tereso et al. 2016*: J. P. Tereso/A. M. S. Bettencourt/P. Ramil-Rego/A. Teira-Brión/I. López-Dóriga/A. Lima/R. Almeida, Agriculture in NW Iberia during the Bronze Age. A Review of Archaeobotanical Data. *Journal of Archaeological Science. Reports* 10, 2016, 44–58.
- Valamoti 2016*: S. M. Valamoti, Millet, the Late Comer. On the Tracks of *Panicum Miliaceum* in Prehistoric Greece. *Archaeological and Anthropological Sciences* 8, 2016, 51–63.
- Valamoti et al. 2011*: S. M. Valamoti/A. Moniaki/A. Karathanou, An Investigation of Processing and Consumption of Pulses among Prehistoric Societies. *Archaeobotanical, Experimental and Ethnographic Evidence from Greece. Vegetation History and Archaeobotany* 20, 2011, 381–396.

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Ivory in the Early Bronze Age of the Southeastern Iberian Peninsula

Keywords: Early Bronze Age, Iberian Peninsula, ivory, scientific analysis, provenance, exchange, social value

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Abstract

By two comprehensive research projects, financed by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG, Bonn) and located at the German Archaeological Institute (Madrid) it was attempted to compile a new catalogue – as complete as possible – of all the ivory objects from the Iberian Peninsula and northwestern Africa dated from the beginning of the Chalcolithic, at about 3200 BC, until the end of the Early Bronze Age, around 1650 BC. Approximately 2000 ivory objects were registered and 150 objects analysed by scientific methods, including measurement of the Schreger angle through optical

microscopy, Fourier Transformed Infrared (FTIR)-Spectroscopy, elemental analysis and Isotopic Ratio Mass Spectrometry. The scientific analyses in combination with the detailed study of the objects and their contexts could give new data regarding the chronological and geographical distribution, their social importance and the origin and exchange of raw material. Two different exchange networks could be recognised, which were active from the Early Chalcolithic until the first stage of the Early Bronze Age by which, on one hand, raw material in the form of complete tusks or parts of them, of Asian ivory; and on the other, African ivory from the Maghreb, reached the Southeast of the Iberian Peninsula. Ivory was worked in some local workshops and then exchanged inland. Whereas during the second half of the 3rd mill. BC ivory still fulfilled an important role as a social marker, in the second stage of the Early Bronze Age (ca. 1900–1650 BC) its social value diminished in benefit of metal items. It is also at this same time that the Asian ivory network was abandoned.

Introduction

The following paper is basically the result of two consecutive research projects on Chalcolithic and Early Bronze Age ivory objects from the Iberian Peninsula, undertaken at the German Archaeological Institute between 2005 and 2012 and financed by the German Research Foundation (DFG), although supplemented by some additional studies.¹ A new catalogue – as complete as

¹ Research projects of the DFG: SCHU-1539/2–1.2 and SCHU-1539/3–1 (Schuhmacher 2012a; 2016a).

possible – of all the ivory objects from the Iberian Peninsula and Northwest Africa dated from the beginning of the Chalcolithic, at about 3200 BC, until the end of the Early Bronze Age, around 1650 BC was compiled. During these studies approximately 2000 ivory objects were recognised and 150 objects analysed by scientific methods, including measurement of the Schreger angle through optical microscopy, Fourier Transformed Infrared (FTIR)-Spectroscopy, elemental analysis and Isotopic Ratio Mass Spectrometry. The scientific analyses in combination with the detailed study of the objects and their contexts could give new data regarding the chronological and geographical distribution, their social importance and the origin and exchange of raw material. This paper will refer basically to the situation during the Early Bronze Age in the southeast of the Iberian Peninsula.

Definition of the Chronological Periods

In order to clearly understand the changes which took place regarding the distribution and understanding of the social value of ivory from the Chalcolithic to the Early Bronze Age three time periods were differentiated: Early and Middle Chalcolithic (ca. 3200–2500 BC), Final Chalcolithic (Bell Beaker period)/Older Early Bronze Age (ca. 2500–1900 BC) and Younger Early Bronze Age (ca. 1900–1650 BC) (Schuhmacher 2012a; 2012b; 2016a). A further distinction between the Final Chalcolithic or Bell Beaker period and the beginning of the Early Bronze Age would be desirable. Nevertheless, it is not always easy to distinguish between the Final Chalcolithic/Bell Beaker complexes, or complexes belonging to the third quarter of the 3rd mill. BC, and others belonging to an incipient Early Bronze Age or the last quarter of the 3rd mill. BC, as in many cases absolute dates are missing. Nevertheless, it was tried to do so, based on absolute dates and a thorough analysis of the material culture. But there are some contexts where this is not possible, influenced also by the absence of a sound definition of an Early Bronze Age and its material culture in many areas of the Iberian Peninsula (see for example Mataloto et al. 2013; García Rivero/Escacena Carrasco 2015; Lillios 2020, 247–251). Nonetheless, at least in the case of the

southeastern quarter of the Iberian Peninsula, on which this article is focusing, the situation is much clearer (Molina et al. 2017).

At the same time, we prefer the denomination ‘Older Early Bronze Age’ and ‘Younger Early Bronze Age’ for the period between approximately 2250–1650 BC, instead of ‘Bronce Antiguo’ and ‘Bronce Pleno’, as in our opinion the real break in the cultural evolution of the Bronze Age, also in the Iberian Peninsula, happened around 1650/1550 BC with the end of the El Argar period in the southeast and the beginning of the so called ‘Bronce tardío’ (‘Middle Bronze Age’ or ‘Period Bz B’ in Central Europe) (Brandherm 2017; Müller-Kissing 2017).

Ivory in the Final Chalcolithic and Bell Beaker Periods (ca. 2500–2250 BC)

Following the investigations, it may be said that regarding the Iberian Peninsula in general during the Final Chalcolithic/Bell Beaker period (ca. 2500–2250 BC), the number of ivory objects increased, compared to the Early and Middle Chalcolithic period, while the total weight diminished (Schuhmacher 2011; 2012a, 300–345, 392–394, table 4; 2012b; 2016a; Valera et al. 2015; Schuhmacher 2017). Thus, now including the register of ivory objects from Valencina de la Concepción completed by Miriam Luciañez Triviño (2018), a total amount of 531 objects for the Early and Middle Chalcolithic with a weight of 9225g can be identified, and for the Final Chalcolithic/Bell Beaker period a total of 921 objects with a weight of 2127.4g. Although, in some cases the number of fragments were included, since due to the high fragmentation, in some occasions it is impossible to calculate the real number of objects. This refers to both periods. In the case of the Final Chalcolithic/Bell Beaker period the new finds from Humanejos (Madrid) were included although their weight is still unknown, but this will not change the general conclusion (Garrido Pena et al. 2019).

During the Final Chalcolithic/Bell Beaker period, by number, mostly buttons are found, followed in this order by beads, pendants and plaques or fittings, blanks or half-finished objects and anthropomorphic idols, besides pins, combs and others (Schuhmacher 2012a, 323 f., table 16; Valera et al. 2015).

At the same time, the geographical distribution of ivory objects expanded in the Final Chalcolithic; the exchange networks within the Iberian Peninsula are growing (Schuhmacher 2012a, 324–327, fig. 89). Therefore, as the weight per piece diminishes and the number of objects per context in most cases is low, it can be concluded that at that moment many small ivory objects were in the hands of many people. Thus, either a certain popularisation and loss of importance of ivory or, on the contrary, the expansion of an elite group can be supposed.

During the second half of the 3rd mill. BC only a few funerary contexts stand out with an extraordinary number and variety of objects related to a small number of deceased people or even individuals, such as the tombs of Matarrubilla (Seville) (Obermaier 1919; Collantes 1969), Los Algarbes 5 (Cádiz) (Posac 1975; Rivero 1988, 82 f.; Mata 1993; García Jiménez et al. 2011) and the Funerary Area 2 of Camino de Yeseras (Madrid) (Liesau et al. 2008; 2011). Funerary Area 2 of Camino de Yeseras represents an inhumation which includes a decorated Bell Beaker ceramic among the grave goods. The respective inhumations of Matarrubilla and Los Algarbes 5, in my opinion, are clearly linked to the Final Chalcolithic, although they did not include objects of the Bell Beaker package, and have been treated in a previous article on ivory resources during the Chalcolithic (Schuhmacher 2017). In tomb 2 of Perdigões (Portugal) approximately 570 highly fragmented ivory elements belong to the second phase of inhumation, dated to the Bell Beaker period (Valera et al. 2015). This tomb represents a collective burial with a large number of dead bodies and without the possibility to attribute these objects to any certain individual. Nevertheless, at least in Matarrubilla, Los Algarbes tomb 5 and the Funerary Area 2 of Camino de Yeseras a few prominent personalities that belong to a growing elite were allowed an individual representation with symbolic objects of ivory and gold (compare Earle 1997, 151 f., 155). As in the previous Pre-Beaker Chalcolithic phase, these characters seem to be those who organised the exchange at a long and medium range. Besides these characters, a larger group of people benefitted from ivory exchange, possessing a few objects made of ivory, but did not have this exposed social position.

Roberto Risch (2018, 55–62) defines the Chalcolithic societies of the Iberian Peninsula as affluent societies. In his opinion the control of the exchange networks in these societies were not directed to foster politically dominant positions, but rather to prevent the concentration of economic and political power. Indeed, during the Iberian Chalcolithic, even during the Final Chalcolithic, excluding maybe Ciempozuelos Beaker inhumations, there is no ‘control or institutionalization of burial practices, aimed at establishing permanent political or economic distinctions within the community’ (Risch 2018, 59). Despite of the lack of elite buildings with signs of surplus accumulation, an elite or at least some extraordinary individuals with high prestige expressed by symbolic objects can be detected. It seems these are the ones who controlled the exchange networks and had the knowledge of distant worlds (compare García Sanjuán et al. 2018). But these positions were not permanent or institutionalised and were, at least in the Early and Middle Chalcolithic, not based on coercion in order to obtain obedience. As Risch (2018) says, these societies might be defined as cooperative affluent societies, where exchange was not meant to reach an individual accumulation of wealth, but a communal one. Nevertheless, at the same time, the organisers and others involved in these transactions obtained more prestige and power, expressed by symbolic objects. On the other hand, also some religious or other specialists were allowed to show such symbols.

García Sanjuán et al. (2018) claim for a growing consolidation of the position of the leaders by the second half of the 3rd mill. BC, visible in some wealthy infant burials and a growing coercive power, expressed by copper daggers in later Bell Beaker tombs. What refers to the contexts treated here, some differences in respect to the Early and Middle Chalcolithic could be observed, as in the rich Late Chalcolithic tombs gold objects and sometimes also weapons, as in tombs 1 and 4 of Humanejos (Garrido Pena et al. 2019, 26–49, 66–87), accompany the ivory items.

Looking in detail to the southeastern Iberian Peninsula, only a few sites show a larger concentration of ivory objects during the Final Chalcolithic/Bell Beaker period (fig. 1). In this sense, the site of Cerro de la Virgen (Orce Granada) with

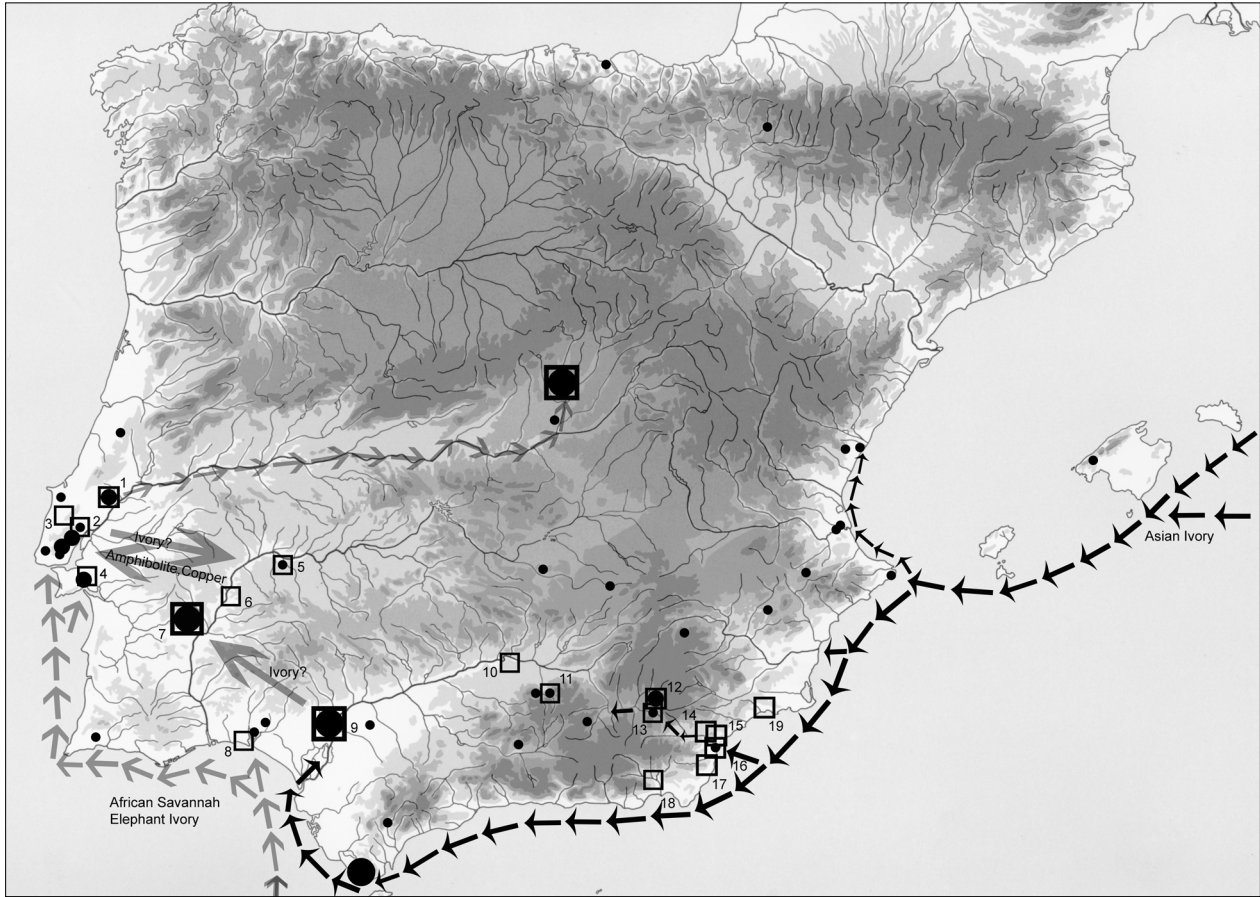


Fig. 1. Final Chalcolithic/Bell Beaker period (ca. 2600/2500–2250 BC). Sites with ivory objects by number (filled symbols) against supposed ‘central places’ (empty symbols) and the routes of ivory exchange. 1 Vila Nova de São Pedro; 2 Pedra do Ouro; 3 Zambujal; 4 Chibanes; 5 La Pijotilla; 6 San Blas; 7 Perdigões; 8 Papa Uvas; 9 Valencina de la Concepción; 10 Albalate-Porcuna; 11 Marroquíes Bajos; 12 Cerro de la Virgen; 13 El Malagón; 14 Campos; 15 Zájara; 16 Almizaraque; 17 Gatas; 18 Los Millares; 19 Cabezo del Plomo. • 1–5 objects; ● 6–20 objects; ● more than 20 objects.

seven ivory buttons with V-perforation belonging to phases IIA–IIC (ca. 2500/2450–2150 BC) can be highlighted.² Among these there are a half-spherical, two ‘tortuga’ (turtle shaped), two prismatic and two pyramidal buttons, as well as one with small lateral appendices. All of the ivory objects from Cerro de la Virgen belong to domestic contexts and not burials, as do approximately 17% of the ivory objects from the second half of the 3rd mill. BC, which amounts to 14% of the gross weight of ivory objects (Schuhmacher 2012a, 324, table 18).

² V.2941; V.1440; V.1287; V.1063; V.1585; V.1502; V.1451. The button V.1452 is according to the optical analysis of Pau (et al. 2018, table 2) made of a boar tusk (Schüle 1980, 34 fig. 6; Schuhmacher 2012a, 488–490; Pau et al. 2018, table 5. Chronology see Molina et al. 2017; Pau et al. 2018, table 1).

Ivory in Older Early Bronze Age Contexts (ca. 2250–1900 BC)

With the beginning of the Early Bronze Age, the distribution of ivory objects throughout the Iberian Peninsula became more restricted and they are now only present in the southeast. This could be influenced by the state of investigation, as the Older Early Bronze Age outside the southeast is still poorly known and defined, or is not easy to distinguish from late Bell Beaker contexts (e.g. Mataloto et al. 2013).

In the southeast of the Iberian Peninsula at the end of the 3rd mill. BC, an increase of the number of ivory objects can be observed, however in this case more clearly linked to the latest Bell Beaker/Older Early Bronze Age contexts, as for example at Cerro

de la Virgen (Granada) and in first order settlements of the early El Argar culture (fig. 1 and 2). In the site of Cerro de la Virgen two prismatic, three pyramidal and one broken button were found in phase IIC/IIIA (ca. 2250–1900 BC), belonging to the Late Bell Beaker/Local Early Bronze Age.³ From the Local Early Bronze Age phase IIIA (ca. 2150–1900 BC) one pendant, six prismatic and two pyramidal buttons made of ivory are reported.⁴

A greater number of ivory objects was also documented in settlement contexts at Cerro de las Víboras (Bagil, Murcia) (Schuhmacher 2012a, 98 f., 490 f., pl. 14: 10–16, 15: 1–2). This includes not only one prismatic and one pyramidal button with a V-perforation, but also two pendants, one of them decorated, and one plaque from level A2. Level A2 probably represents an older phase of El Argar culture.⁵

But in all these cases the objects belong to domestic contexts. In comparison, the number of tombs dating to the beginning of the Early Bronze Age that include ivory objects as grave goods is very small. Here, El Argar, tomb 89 with an ivory piece and a golden ring can be quoted (Schubart/Ulreich 1991, 77, pl. 8: 89). Of special interest is the case of the tomb of Molinos de Papel (Murcia) that contained two very large conical buttons, probably sewn on the garment at the top of the shoulder and that could be part of a ceremonial dress, three prismatic buttons and two preforms for the production of prismatic buttons (Marín et al. 2012). This context reminds us of similar arrangements from some Late Chalcolithic contexts, as is the case in Camino de Yeseras, Matarrubilla or Los Algarbes tomb 5 as a representation with symbolic objects made of ivory from a few prominent

personalities. The other grave goods, such as two ceramic vessels, an awl and a dagger made of metal, fit quite well with standard inhumations of women in the Early El Argar culture, whereas the perforated stone plaque ('wrist-guard') is more typical for male burials (Marín et al. 2012, 168). Therefore, a reminiscence of older, Late Chalcolithic traditions in an Early Bronze Age context can be detected.

The cultural adscription of the individual tomb at Cerro de las Viñas (Coy, Murcia) (Schuhmacher 2012a, 98, 491 f., pl. 15: 3–9) is not finally settled. This inhumation contained six pyramidal and one prismatic ivory button and a wrist-guard fragment of stone. Outside the grave pit, next to the tomb, a fragment of the same wrist-guard, a dagger and a Palmela point made of copper were found. This tomb is dated, due to the Palmela point, by some authors to the Bell Beaker phase, present at the site (Ayala 1991, 55–98, 198, 468, fig. 68, 75, 76; Lull et al. 2015, 403; Mederos 2020, 215). Nevertheless, J. A. López Padilla (2006, 6) questioned the adscription of the Palmela point to this burial. In his opinion all the other objects and the burial rite are fully compatible with early El Argar burials, although pyramidal buttons are indeed also present in Bell Beaker contexts. In any case, whether it belongs to one cultural manifestation or the other, this context is to be considered part of the ivory network that existed during the end of the Bell Beaker and start of the Older Early Bronze Age.

In conclusion, during the early El Argar culture, the number of tombs with ivory objects presented as offerings is very small. Ivory still seems to fulfil its role as prestige object, as only a few individuals receive ivory objects into the tomb. Still – as in the previous Bell Beaker period – some individuals with a high status or prestige are allowed a sumptuous image cultivation through the use of public symbols, maybe wearing a ceremonial dress linked to their official duty or position with a larger number of ivory objects sewn on the dress.

At the same time, only two contexts with ivory objects both dating to the beginning of the Early Bronze Age and coming from contexts of the Valencian Bronze Age or the Bronze Age of La Mancha are recognised (Schuhmacher 2012a, 334–344, fig. 100). These are Cova de la Barcella

³ V.784; V.943; V.968; V.974; V.985; V.1126 (Schüle 1980, 34, fig. 6; Schuhmacher 2012a, 488–490; Pau et al. 2018, table 5. Chronology see Molina et al. 2017; Pau et al. 2018, table 1).

⁴ V.625; V.626; V.627; V.635; V.639; V.758; V.773; V.778. Schüle 1980, 34, fig. 6; Schuhmacher 2012a, 488–490; Pau et al. 2018, table 5. The button V.638 (not included in this count) is made out of a boar tusk and V.625 out of a teeth of a sperm whale (following the optical analysis of Pau et al. 2018, table 2). Chronology see Molina et al. 2017; Pau et al. 2018.

⁵ There is only one absolute date available for level A2: I-18050: 3850 ± 110 BP = 2470–2140 calBC (1σ) (Eiroa 1998, table 2; Schuhmacher 2012a, 98 f., catalogue 3).

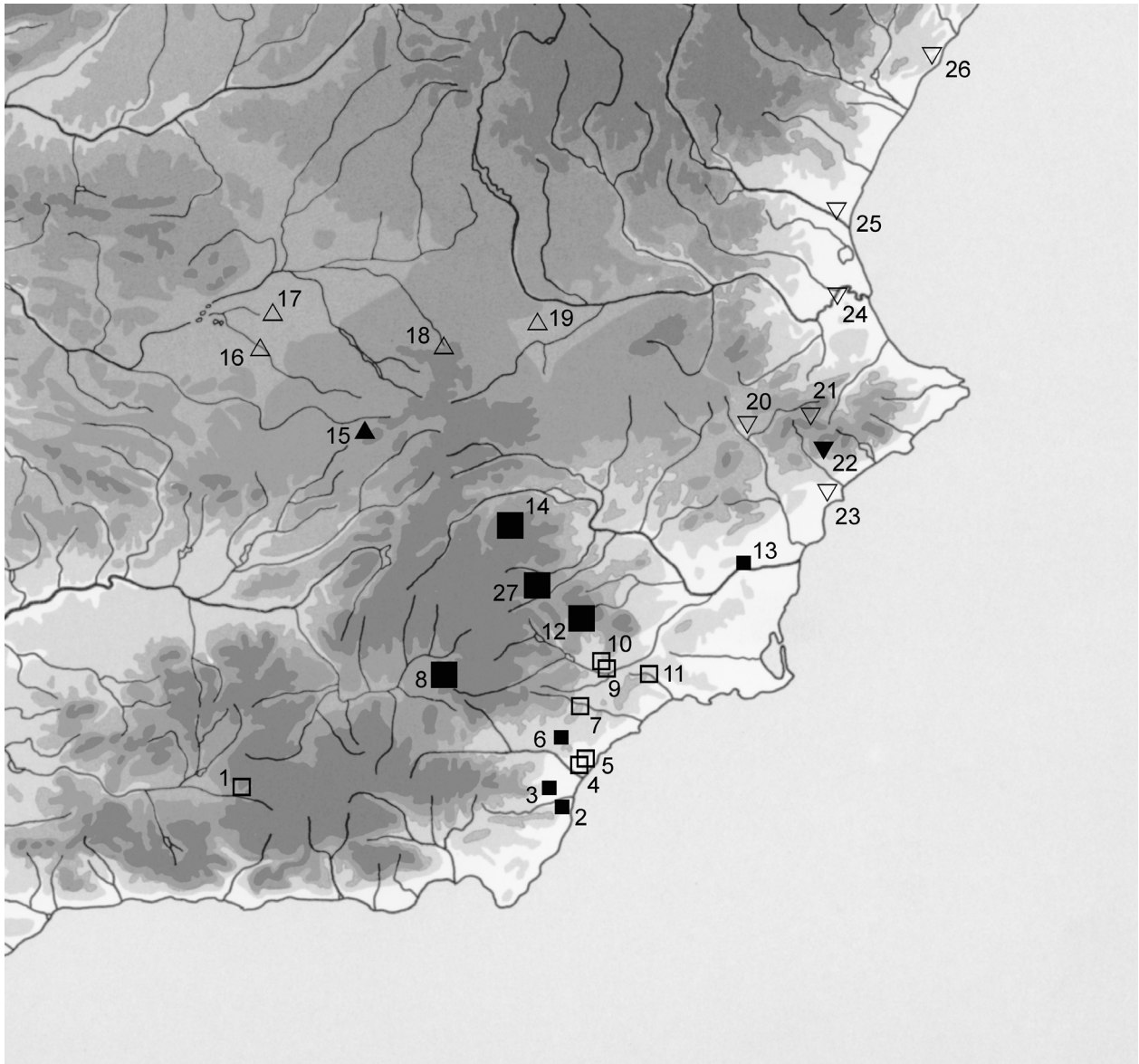


Fig. 2. Older Early Bronze Age (ca. 2250–1900 BC). Sites with ivory objects by number (filled symbols) against sites dated by radiocarbon dates (empty symbols) and differentiated by their cultural assignment: □ El Argar, ▽ Bronce Valenciano, △ Bronze Age of La Mancha. 1 Cerro de la Encina; 2 Gatas; 3 El Argar; 4 Herrerías; 5 El Oficio; 6 Fuente Álamo; 7 El Rincón de Almendricos; 8 Cerro de la Virgen (Orce); 9 Lorca, city centre; 10 Los Cipreses; 11 La Ceñuela; 12 Cerro de las Viñas; 13 San Antón; 14 Cerro de las Víboras; 15 Castillejo del Bonete; 16 El Azuer; 17 Motilla de los Romeros; 18 El Quintanar, 19 El Acequiión; 20 Terlinques; 21 Mas del Corral; 22 Cova de la Barcel·la; 23 Serra Grossa; 24 Muntanya Assolada; 25 Lloma de Betxí; 26 Orpesa la Vella; 27 Molinos de Papel.

(Torremanzanas, Alicante) (Soler 2002, Vol. I, 380, pl. 196: 79) and tomb 4 of Castillejo del Bonete (Terrinches, Ciudad Real) (Benítez de Lugo et al. 2015) (*fig. 2*). The latter is a double inhumation of a 40 to 60 year-old man and a 40 year-old woman and is dated by one radiocarbon date to: Rome-1687: 3720 ± 70 BP = 2340–1921 calBC (2σ). Close to the corpse of the woman two ivory buttons were found. Beside the man's body lay a stone

'wrist-guard' and a ceramic vessel, inside which a copper awl and dagger were placed, and another copper dagger close to the hip. One button is of conical form with an oval basis, and the other one is pyramidal.

As López Padilla has demonstrated, the number of pyramidal buttons is quite high during the Early Bronze Age in the southeast, especially linked to the El Argar culture (López Padilla 2006).

This is also valid for the examples made of ivory. Therefore, outside the territory of El Argar, they only occasionally appear, as unique pieces, as is the case of Castillejo del Bonete (Schuhmacher 2012a, 169–181, fig. 50; Benítez de Lugo et al. 2015, 54 f., fig. 14).

The ivory objects from Castillejo del Bonete are by now the only ones present in La Mancha from the end of the 3rd mill. BC (fig. 2). It also has to be taken into account that double inhumations are not frequent in the Bronze Age of La Mancha but are a peculiar trait of the El Argar culture (Ulreich 1991, 383–390; Lull 2000; López Padilla et al. 2006; Benítez de Lugo et al. 2007). So, for example, among the more than 30 inhumations at the site of El Acequión (Albacete), there is not one double inhumation. Furthermore, the carbon and nitrogen isotope analysis of the two individuals revealed a certain amount of marine food for the woman but not for the man, thus pointing to a different geographic origin of the woman, which would be coastal (Benítez de Lugo et al. 2015, 46). This might indicate that ivory objects are reaching La Mancha and the region of Alicante by transmission from the area of El Argar. It is even possible that the woman from the Castillejo del Bonete burial was native to the El Argar territory and moved inside La Mancha with her local dress, including the ivory buttons.

The Younger Early Bronze Age (ca. 1900–1650 BC)

A total of 307 ivory objects with a weight of only 550.9g belong to the Younger Early Bronze Age, (Schuhmacher 2012a, 349–351, tables 25–27). 42% of the objects are buttons with V-perforation and 53% came out of individual or double inhumations. 45% of the objects were found in settlements. Until now, with the exception of the prismatic button from the inhumation of Santioste (Delibes et al. 1998; Schuhmacher 2012a, 362 n°. 991) and the objects from Can Martorell (Mallorca) (Pons 1999; Schuhmacher 2012a, 362 n°. 214–223), objects made of ivory and dated to the Younger Early Bronze Age could only be registered in the southeastern part of the Iberian Peninsula (fig. 3). Neither was any object found in

Portugal nor in the Spanish southwest, although this could be due to a lack of investigation in these two areas, where the Early Bronze Age is still not defined well (Mataloto et al. 2013; García Rivero/Escacena Carrasco 2015; Lillios 2020, 247–251).

Important concentrations of objects are registered in the Vera basin (Fuente Álamo and El Argar), the coast of Alicante (Illeta dels Banyets) and the eastern Mancha (El Acequión). Other significant finds were located at Cerro de la Encantada (Granátula de Calatrava, Ciudad Real) as well as Cerro del Cuchillo (Almansa, Albacete) for the Bronze Age of La Mancha and Lloma de Betxí (Paterna, Valencia) for the Valencian Bronze.

It is interesting to compare the number and weight of ivory objects from these three Early Bronze Age cultures (Schuhmacher 2012a, 352–362, tables 28–30, fig. 106–107) (table 1). Looking at the sum of all objects belonging to the Early Bronze Age (ca. 2250–1650 BC), although the majority of the objects belongs to El Argar contexts (319 objects) and only 100 objects to the Bronze Valenciano and 98 more to the Bronze Age of La Mancha, the altogether weight of these objects is almost the same in El Argar as in the Mancha Bronze Age, 443.4g against 449.4g, but smaller for the Valencian Bronze (264.4g). This means that the objects made of ivory are larger and heavier in the Mancha than in the sites of El Argar, what is illustrated by some big and heavy buttons from El Acequión and El Quintanar (Schuhmacher 2012a, colour pl. 6c, e–f, pl. 20: 1–3, 23: 1).

Although a secure chronology cannot be given to the majority of the contexts with ivory belonging to the Valencian Bronze and the Bronze Age of La Mancha, it seems sound to suppose that most of these finds belong to the Younger Early Bronze Age. If this was true, the weight of ivory objects in the younger El Argar culture (Argar B) would be smaller than in the contemporaneous Valencian Bronze and Bronze Age of La Mancha, as there are 232 items with a weight of 139.4g, which clearly can be dated to the younger El Argar culture (Schuhmacher 2012a, tables 28–29). There are several possible explanations for this fact. In all three cases mostly buttons are present, but in El Argar contexts predominantly pyramidal and short prismatic buttons can be found, whereas in La Mancha and the Valencian Bronze

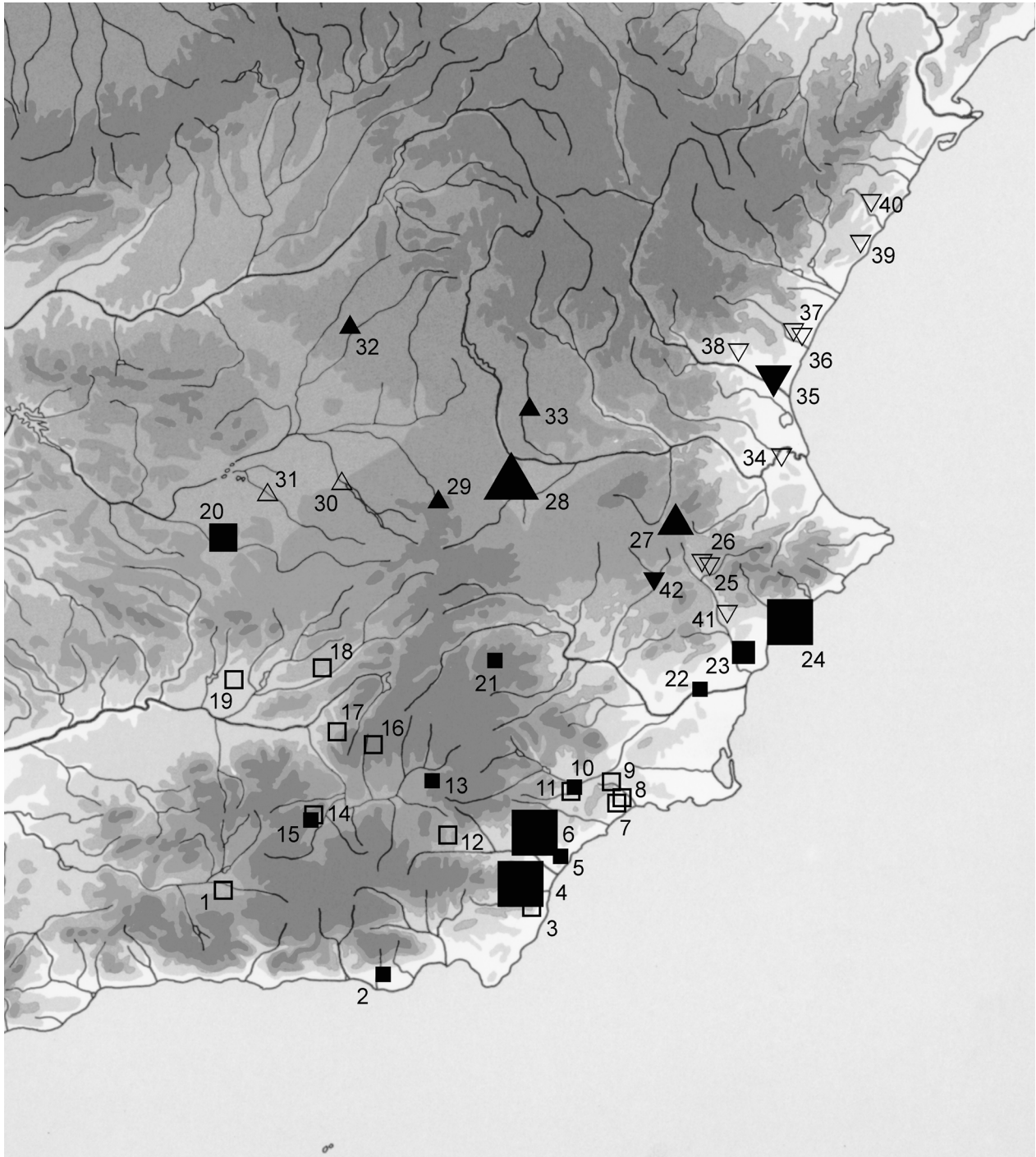


Fig. 3. Southeastern Iberian Peninsula during the Younger Early Bronze Age (ca. 2000/1900–1650 BC). Ivory objects by number (filled symbols) against sites dated by radiocarbon (empty symbols) and differentiated by their cultural assignment: ■ El Argar culture, ▼ Bronze Valenciano, ▲ Bronze Age of La Mancha. 1 Cerro de la Encina; 2 Cerrillo de Ciavieja; 3 Gatas; 4 El Argar; 5 El Oficio; 6 Fuente Álamo; 7 Zapata; 8 Cabezo Negro; 9 La Ceñuela; 10 Los Cipreses; 11 Lorca: city centre; 12 El Picacho; 13 Cerro de la Virgen; 14 Cerro de los Castellones; 15 Las Peñuelas; 16 Castellón Alto; 17 Terrera del Reloj; 18 Rincón de Olvera; 19 Peñalosa; 20 Cerro de la Encantada; 21 Cerro de las Víboras; 22 San Antón; 23 Caramoro I; 24 Illeta dels Banyets; 25 Barranco Tuerto; 26 Cabezo Redondo; 27 Cerro del Cuchillo; 28 El Acequión; 29 El Quintanar; 30 Sta. María del Retamar; 31 El Azuer; 32 Cueva del Fraile; 33 Cerro del Cuco; 34 Muntanya Assolada; 35 Lloma de Betxí; 36 Pic dels Corbs; 37 Les Raboses; 38 Puntal dels Llops; 39 Orpesa la Vella; 40 Mas d'Abad; 41 Lloma Redona; 42 Cerro de la Campana.

	Early Bronze Age											
	El Argar				Bronce Valenciano				La Mancha			
	number		weight (g)		number		weight (g)		number		weight (g)	
	n	%	g	%	n	%	g	%	n	%	g	%
Cave-sites	0	0	0	0	8	5.9	1	0.4	3	3.1	0	0
Megalithic tombs	6	1.9	31.5	7.1	0	0	0	0	0	0	0	0
Individual tombs	194	60.8	86.6	19.5	0	0	0	0	3	3.1	41	9.1
Settlements	119	37.3	325.3	73.4	127	94.1	263.4	99.6	92	93.9	408.4	90.9
Single finds	0	0	0	0	0	0	0	0	0	0	0	0
Sum	319	100	443.4	100	135	100	264.4	100	98	100	449.4	100

Table 1. Early Bronze Age (ca. 2250–1650 BC). Ivory objects by their cultural adscription and context type.

there are a majority of long prismatic buttons with one V-perforation on each end, so they are bigger and heavier (Schuhmacher 2012a, 169–202, fig. 50, 52–53). Probably, there are cultural explanations linked to the traditional costumes. Nevertheless, the answer might lie in the burial rites and different social value of ivory.

In the Younger Early Bronze Age, the percentage of tombs from the El Argar culture which contain ivory is low (Schuhmacher 2012a, 396–400, table 31). Thus, for the site of El Argar about 26 of approximately a total of 980 tombs (2.7%) can be counted. Fifteen of these tombs also contained silver objects, among them are four of the tombs with diadems. In two of the tombs, Argar 429 and Fuente Álamo 9, a sword, a very exclusive item, is also present.

Using Lull's and Estévez's classification (Lull/Estévez 1986, 449 f.; Lull et al. 2011) as a basis, 18 of the 26 tombs would belong to the highest categories 1 and 2 (Schuhmacher 2012a, 396–400, table 31). This indicates the high value of ivory. But it is also clear that ivory alone no longer seems to be an indicator of social status, instead it is the combination of ivory with other elements. In fact, the presence of ivory is often restricted to some buttons or beads besides gold or silver objects, swords, halberds or diadems. There is a clear change in the perception and social value of ivory

if we compare the situation, for example, with the tombs of Matarrubilla, Los Algarbes 5 or Camino de Yeseras, belonging to the Final Chalcolithic, or even the tombs of Molinos de Papel, or maybe Cerro de las Viñas, from the early El Argar culture. An exception is tomb III of Illeta dels Banyets (El Campello, Alicante), where the only grave-goods are ivory buttons, 54 in total (Schuhmacher 2012a, 510–514, pl. 26: 5–39, 27: 1–19). In this case the buttons were probably sewed to the garment and part of a ceremonial dress.

Scientific Analysis of Ivory

For the Older Early Bronze Age, together with A. Banerjee, some objects could be analysed, all belonging to the El Argar culture, in order to determine the type of raw material that was used (Schuhmacher 2016a, 117–150, catalogue 2) (table 2). Six samples from an ivory workshop in Fuente Álamo, a big pyramidal button from Molinos de Papel and fragments from La Bastida de Totana were determined as coming from African savannah elephant (*Loxodonta Africana africana*). Recently Pau et al. (2018) analysed the ivory objects from Cerro de la Virgen. Following these results among the buttons from phases IIC/IIIA (Late Bell Beaker/Local Early Bronze Age) and IIIA

Sites and phases	<i>Elephas maximus</i>	<i>Loxodonta africana</i>	<i>Elephas antiquus</i>	<i>Hippopotamus amphibius</i>	<i>Physeter macrocephalus</i>	Sum	Bibliography
Fuente Álamo Phase II	0	2	0	0	0	2	Schuhmacher 2016, catalogue 2
Molinos de Papel	0	1	0	0	0	1	Schuhmacher 2016, catalogue 2
La Bastida	0	3	0	0	0	3	Schuhmacher 2016, catalogue 2
Cerro de la Virgen Phase IIC/ IIIA	2	0	0	1	0	3	Pau et al. 2018
Cerro de la Virgen Phase IIIA	1	1	0	2	1	5	Pau et al. 2018
Sum	3 (21.4%)	7 (50%)	0	3 (21.4%)	1 (7.1%)	14 (100%)	

Table 2. Older Early Bronze Age. Scientific analysis of ivory objects and their results.

(Local Early Bronze Age), ivory from Asian elephants was present in three instances, one from African savannah elephant, three objects made of hippopotamus ivory (*Hippopotamus amphibius*) and one was worked out of sperm whale ivory (*Physeter macrocephalus*). Therefore, in total there is 50% of African elephant ivory, 21.4% of both Asian elephant and hippopotamus ivory, and 7.1% of sperm whale ivory.

These results can be compared with analysis done on ivory objects from Final Chalcolithic/Bell Beaker contexts. The available analyses are the one we did together with A. Banerjee and others (Schuhmacher 2016a, 117–150, catalogue 2; Schuhmacher/Banerjee 2019), the analysis carried out by C. Liesau (2016) and the ones by Pau et al. (2018) (table 3). It seems clear that the raw material employed changes from the Final Chalcolithic/Bell Beaker horizon to the beginning of the Early Bronze Age. In Final Chalcolithic/Bell Beaker contexts a much higher percentage of locally available ivory can be observed, such as ivory belonging to *Elephas antiquus* (32.7%) and sperm whale (29.1%). Combined, they reach almost 62% in the Final Chalcolithic/Bell Beaker horizon. It is assumed that this refers to fossil resources from the Iberian Peninsula and sperm whales beached at the coasts of the Iberian Peninsula (Schuhmacher et al. 2013). On the contrary, Asian elephant ivory reaches 21.8%, African elephant ivory only 10.9%

and hippopotamus 5.5%. This fact was explained defending the existence of a large demand of ivory during this period, which was impossible to satisfy via superregional trade due to the distance from resources.

It has to be kept in mind that the mentioned analyses for the Final Chalcolithic/Bell Beaker period cover the whole southern part of the Iberian Peninsula and not only the southeast. In contrast, the number of analyses of samples from the Final Chalcolithic/Bell Beaker period done for the southeastern part of the Peninsula, alone, is still very small (nine samples). Here, for this time period, the percentage of Asian elephant ivory is 55.6% (five samples), while African elephant and hippopotamus ivory are both 22.2% (two samples each) and not any *Elephas antiquus* or sperm whale ivory could be detected. Therefore, it is not clear whether the for the total of the Iberian Peninsula observed tendency of the decrease of locally available ivory (*Elephas antiquus* and sperm whale) (no samples), and a change from mainly Asian elephant ivory to African elephant ivory also applies to the southeast.

But seemingly, at the beginning of the Early Bronze Age, the percentage of *Elephas antiquus* and sperm whale ivory is shrinking, whereas that of African savannah elephant ivory is growing and becoming the most important resource (50%). Nevertheless, the small sample (14) for the

Sites and phases	<i>Elephas maximus</i>	<i>Loxodonta africana</i>	<i>Elephas antiquus</i>	<i>Hippopotamus amphibius</i>	<i>Physeter macrocephalus</i>	Sum	Bibliography
Verdelha dos Ruivos Level I	0	0	0	0	4	4	Schuhmacher 2016, catalogue 2
Verdelha dos Ruivos Level II	0	0	0	0	1	1	Schuhmacher 2016, catalogue 2
Palmela	0	0	0	0	2	2	Schuhmacher 2016, catalogue 2
Pedra do Ouro	0	0	0	0	5	5	Schuhmacher 2016, catalogue 2
Dolmen das Conchadas	0	0	0	0	3	3	Schuhmacher 2016, catalogue 2
Convento do Carmo	0	0	0	1	0	1	Schuhmacher/Banerjee 2019
Perdigões	0	1	0	0	0	1	Schuhmacher 2016, catalogue 2
La Orden Seminario de Huelva	0	1	0	0	0	1	Schuhmacher 2016, catalogue 2
Los Algarbes tomb 5	1	0	1	0	0	2	Schuhmacher 2016, catalogue 2
Matarrubilla	6	0	6	0	0	12	Schuhmacher 2016, catalogue 2
Camino de Yeseras, hypogeum	0	1	9	0	0	10	Schuhmacher 2016, catalogue 2
Camino de Yeseras, hypogeum	0	0	0	0	1	1	Liesau 2016
Humanejos	0	0	2	0	0	2	Liesau 2016
Ciempozuelos	0	1	0	0	0	1	Liesau 2016
Southeast							
El Argar	1	0	0	0	0	1	Schuhmacher 2016, catalogue 2
Gatas	1	0	0	0	0	1	Schuhmacher 2016, catalogue 2
Cerro de la Virgen Level II	0	0	0	1	0	1	Pau et al. 2018
Cerro de la Virgen Level IIA/B	2	1	0	1	0	4	Pau et al. 2018
Cerro de la Virgen Level IIB	0	1	0	0	0	1	Pau et al. 2018
Cerro de la Virgen IIB/C	1	0	0	0	0	1	Pau et al. 2018
Sum	12 (21.8%)	6 (10.9%)	18 (32.7%)	3 (5.5%)	16 (29.1%)	55 (100%)	

Table 3. Final Chalcolithic/Bell Beaker period. Scientific analysis of ivory objects and their results.

Sites and phases	<i>Elephas maximus</i>	<i>Loxodonta africana</i>	<i>Elephas antiquus</i>	<i>Hippopotamus amphibius</i>	<i>Physeter macrocephalus</i>	Sum	Bibliography
El Oficio tomb 265	0	0	1	0	0	1	Schuhmacher 2016, catalogue 2
Fuente Álamo phase III	0	3	0	0	0	3	Schuhmacher 2016, catalogue 2
Fuente Álamo tomb 105	0	1	0	0	0	1	Schuhmacher 2016, catalogue 2
Cerro de la Virgen Phase IIIB	0	1	0	0	0	1	Pau et al. 2018
Las Peñuelas tomb 9	0	0	2	0	0	2	Schuhmacher 2016, catalogue 2
Las Peñuelas tomb 10	0	0	1	0	0	1	Schuhmacher 2016, catalogue 2
Illeta dels Banyets, settlement	0	0	0	2	0	2	Schuhmacher 2016, catalogue 2
Cabezo del Navarro	0	2	0	0	0	2	Schuhmacher 2016, catalogue 2
El Tabayà	0	2	0	0	0	2	Schuhmacher 2016, catalogue 2
El Acequión	0	1	0	0	0	1	Schuhmacher 2016, catalogue 2
Can Martorellet	0	10	0	0	0	10	Schuhmacher 2016, catalogue 2
Sum	0	20 (76.9%)	4 (15.4%)	2 (7.7%)	0	26 (100%)	

Table 4. Younger Early Bronze Age. Scientific analysis of ivory objects and their results.

contexts of the Older Early Bronze Age, and the fact that in some cases a true adscription to a Final Chalcolithic/Bell Beaker or Early Bronze Age context is difficult, have to be considered.

It seems like complete tusks or secondary blocks were imported to the southeast of the Iberian Peninsula and worked locally, as demonstrated by several fragments of production waste identified in horizons I and II of Fuente Álamo, which can be related with one building in the case of horizon II (Liesau/Schuhmacher 2012, fig. 8; Schuhmacher 2012a, 368–371, fig. 114). Furthermore, half-finished objects for the production of buttons are found in Molinos de Papel, Las Peñuelas 9 (Laborcillas, Granada), El Argar (Antas, Almería), Mola d'Agres (Agres, Alicante) and Cueva de Cirat (Montán, Castellón) (Schuhmacher 2012a, 291–293), although with the exception of Molinos

de Papel, the exact chronology of these contexts is not clear.

For the Younger Early Bronze Age currently 26 analyses are available (Schuhmacher 2016a, 117–150, catalogue 2; Liesau 2016; Pau et al. 2018) (table 4). In 20 cases (76.9%) the result was African savannah elephant, four samples belonged to *Elephas antiquus* (15.4%) and two instances to hippopotamus (7.7%). Until now no piece could be ascribed to *Elephas maximus*.

The fragments of production waste and half-finished objects found in the surroundings of building I of Horizon III from Fuente Álamo (Almería) suggests that inside this building ivory was worked (Schuhmacher 2012a, 371–379, 440 f.; Liesau/Schuhmacher 2012). We can identify at least, due to the production waste located there, one more ivory workshop from the same time

period in Illeta dels Banyets (Alicante) (Belmonte/López Padilla 2006, 184–186). Outside the El Argar territory, in Mola d'Agres, Muntanyeta de Cabrera, Cerro del Cuchillo and El Acequi6n (Albacete) concentrations of fine ivory disks and/or half-finished objects have been documented (Schuhmacher 2012a, 371–379, 440 f.). This might indicate the existence of workshops, but other elements such as production waste are missing (Luciañez Triviño 2018, 552–557). At the moment we are inclined to define these contexts as simple storehouses of objects, which are in progress or designated for exchange. Nevertheless, it can be confirmed that at least in the territory of the El Argar culture raw material in the form of complete tusks or parts of them were imported and worked locally. In contrast to the situation during the Older and Middle Chalcolithic, where a complete tusk of an African elephant was documented in Valencina de la Concepci6n (García Sanjuán et al. 2013), until now no complete tusk nor secondary blocks have been registered for the Early Bronze Age.

Source and Exchange Routes

As already explained in other papers, the nearest source for Asian elephant ivory in the 3rd mill. BC would be the Levant, where populations of the so-called Syrian elephant, in fact a variant of the Asian elephant, were still available (Nocete et al. 2013; Pfälzner 2013; Vila 2015; Schuhmacher 2016a, 106–108; 2017). A supply of Asian elephant ivory to the Iberian Peninsula from or via Syria seems therefore possible. But the problem is that the few studies undertaken until now suggest that in the Levant as well as in Egypt, Crete and Greece, up until the beginning of the Final Bronze Age, the most commonly used ivory was hippopotamus ivory (Banerjee et al. 2017, 96–98). The problem is not only the geographic origin of the raw material but also the routes and the mode of exchange. Unfortunately, detailed studies of the ivory objects documented in Italy, southern France, Corsica and Sardinia, and of course scientific analyses of the type and origin of this ivory, are still missing for almost the whole of the Mediterranean outside the Iberian Peninsula. Only recently a new study on 30 objects from the hypogeum of Padre Iossu

(Sardinia), which contains inhumations from the Bell Beaker period, shows a mix of ivory from African savannah elephant and Asian elephant (Morillo 2015, 32–37; Morillo et al. 2018). This might indicate part of a route over which Asian elephant and hippopotamus ivory reached the Iberian Peninsula from the Near East, as this zone seems to be the most likely origin for both types of raw material (Schuhmacher 2016a, 104 f.) (fig. 1). But a sound reconstruction of the exact process of exchange still seems far away, as it is unknown what exactly reaches the Near East in exchange, nor is it clear whether this was a down-by-line or direct exchange network (Schuhmacher 2016b, 34).

As showed, the Early Bronze Age contexts of the end of the 3rd mill. BC in the Iberian Peninsula contain mostly African elephant ivory. A large amount of figurative representations of elephants in North African rock art are known, for example in Morocco, south of the Atlas, as well as bone remains and tusks, further on literal sources and figurative representations from Punic and Roman times talking about their presence until the 8th cent. AD (Banerjee et al. 2011a; 2011b; Schuhmacher 2012a, 406–409, fig. 147; 2016a, 110–116, fig. 19–20). It could be affirmed that this North African elephant belonged to the species *Loxodonta africana africana* or African savannah elephant, detected in our analysis on ivory objects from the Iberian Peninsula and the Maghreb, although zooarchaeological analysis of remains of the North African elephant are still sparse (Banerjee et al. 2011a; Schuhmacher 2016a, 112–116).

As for the Bell Beaker period, several objects can be named: Bell Beakers themselves, Palmela points, a halberd, a tanged dagger, metal awls and a wrist-guard which probably reached the northwest of Africa in exchange for ivory (Schuhmacher 2017). But such exchange is much more difficult to affirm for the Early Bronze Age. Only six bronze axes found in Saint-Eugène, Lamoricière, Cherchel, Columnata (Tiet, all Algeria), Oued Akrech and Kaf Taht el Ghar (Tétouan, both Morocco) can be named (Schuhmacher 2016a, 194–197; 2016b, 39–42). The axes find parallels in the types Monteagudo 8A and 8B, present in the Southeast of the Iberian Peninsula (Monteagudo 1977, 81–87, no. 457–462, 472–515A, pl. 25–27). Another flanged copper axe

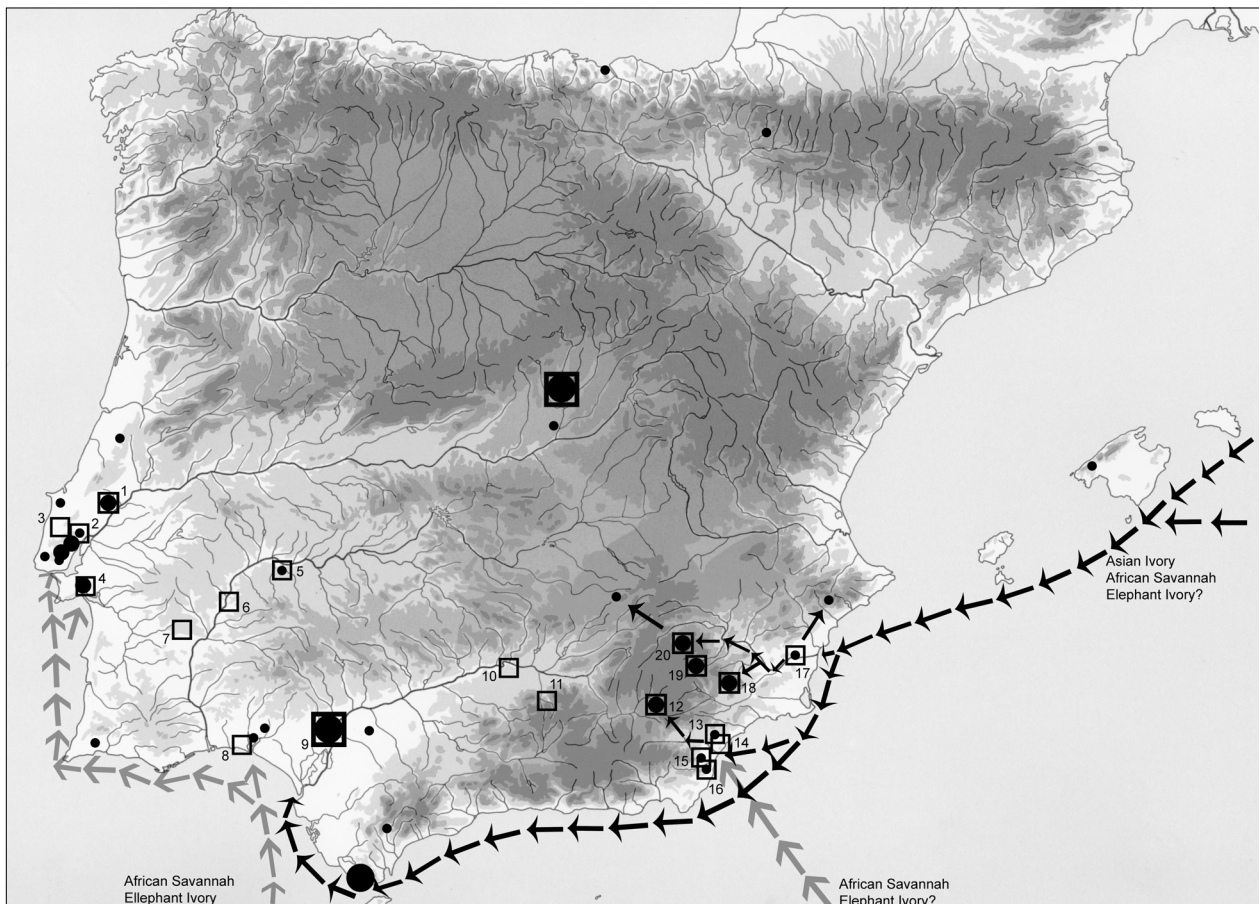


Fig. 4. Final Chalcolithic/Bell Beaker period in the west and Older Early Bronze Age in the southeast of the Iberian Peninsula. Provenance and routes of exchange for ivory against the distribution of ivory objects by number (filled symbols) and the possible 'central places' (empty symbols). 1 Vila Nova de São Pedro; 2 Pedra do Ouro; 3 Zambujal; 4 Chibanes; 5 La Pijotilla; 6 San Blas; 7 Perdigiões; 8 Papa Uvas; 9 Valencina de la Concepción; 10 Albalate-Porcuna; 11 Marroquíes Bajos; 12 Cerro de la Virgen; 13 Fuente Álamo; 14 El Oficio; 15 El Argar; 16 Gatas; 17 San Antón; 18 Cerro de las Viñas; 19 Molinos de Papel; 20 Cerro de las Víboras. • 1–5 objects; ● 6–20 objects; ● more than 20 objects.

from Kaf Taht el Ghar resembles type 13A-C of Monteagudo, whereas there is not enough information regarding a flanged axe with stop bevel from Saint-Eugène. In the same site of Kaf Taht el Ghar a fragment of an El Argar form 6 (classification after Siret/Siret 1887) vessel in a variant typical for the younger Early Bronze Age could be identified (Ramos et al. 2008, 254 f., cat no. 33; Schuhmacher 2016a, 194–197, fig. 55–56). A similar vessel, together with a small bowl, seems to be present in tomb 2 of the necropolis of Mers (Tangier, Morocco). Tombs 8 and 10 of the same site delivered metal awls. It also seems sound to relate the ceramic bowl from tomb 67 in Aïn Dalia (Tangier) with the Iberian Early Bronze Age.

Other hints for these relations are more difficult to evaluate, such as the representation of possible Iberian dagger forms in several rock art sites of the High Atlas or the supposed inhumations in pithoi in Zemamra (Mazagan) (Souville 1968, 48 f.; 1986, 107; 1988, 291).

Here it also has to be kept in mind that not only an exchange of objects has been documented, but that anthropological DNA analysis made in Camino de Yeseras seems to confirm an occasional movement of people of African origin (Olalde et al. 2019; Liesau/Blasco 2019).

Nevertheless, this seems to indicate a re-orientation of the exchange networks probably towards North African resources between the Final

Chalcolithic and the Younger Early Bronze Age, and the abandonment of the exchange route with the Near East. But in two cases hippopotamus ivory in a context of the Younger Early Bronze Age (Illeta dels Banyets) as well as in a small number in Final Chalcolithic/Bell Beaker and Older Early Bronze Age contexts could be found. With regards to hippopotamus ivory, its exact provenance is still unknown. The nearest source in that time period would be sub-Saharan Africa, Mauritania, Mali, Chad, or Egypt, as there is no data regarding the existence of hippopotamus near the Atlantic coast of Morocco during the Holocene (Schuhmacher 2016a, 104 f.; Banerjee et al. 2017, 96–99). Other possible sources would be Syria and Palestine, which makes sense, taking into account that at the same time ivory from Asian elephant is present, as is the case for the Bell Beaker and Older Early Bronze Age contexts. But finally, it seems not possible to decide whether in the Younger Early Bronze Age the contacts with the Near East were totally abandoned or not, and whether some hippopotamus ivory still arrived or whether this type of ivory now came via northwestern Africa from sub-Saharan sources. In fact, the last possibility seems more probable.

During the Older Early Bronze Age, African and Asian elephant ivory reached, in the form of raw material (complete tusks or parts of them), the estuaries of the rivers Almanzora (Fuente Álamo, El Oficio, Gatas and El Argar) and Segura (San Antón), where it was worked and exchanged inland as finished or half-finished objects, occasionally reaching the areas of the Mancha Bronze Age culture and of the Valencian Bronze (Schuhmacher 2012a, 429–432, fig. 157; 2016a, 190–193, fig. 53) (fig. 4). This vision is based almost exclusively on the distribution of ivory throughout the Iberian Peninsula and Northwest Africa, and the results of the scientific analysis, however it is still impossible to name the objects that reached the Maghreb in exchange for the ivory.

Later, at the beginning of the 2nd mill. BC, African elephant ivory almost exclusively reached the Iberian Peninsula from the region of Oran, the east of Algeria, but also the zone between Rabat and Casablanca, where metal axes and ceramics,

which probably came there from the Iberian Peninsula in exchange can be located (Schuhmacher 2016a, 194–201, fig. 57–58) (fig. 5). We propose that this ivory was transported in first line to the coast of Alicante (Illeta dels Banyets) and the Vera basin (El Argar and Fuente Álamo), from where ivory products, maybe also blanks or half-finished objects, were exchanged inland. The high number of ivory objects present in the area of the Valencian Bronze and their specific design (long prismatic buttons) as well as the possible workshops in Mola d'Agres (Agres, Alicante) and Muntanyeta de Cabrera (Vedat de Torrent, Valencia) support the idea that the coastal settlements of the Valencian Bronze, such as Lloma de Betxí (Paterna, Valencia) and Muntanyeta de Cabrera, from that time on participated more directly in the exchange and processing of ivory (Schuhmacher 2012a, 372). The site of Cerro del Cuchillo (Almansa, Albacete), where some hints of local ivory working have been found, probably played an important role for the reception, processing and exchange of ivory for the Bronze Age culture of La Mancha.

Whereas for the Final Chalcolithic/Bell Beaker period a few burials in northwestern Africa could be detected containing objects obtained through exchange with the Bell Beaker elites of the Iberian Peninsula, thus indicating the formation of a local elite in northwestern Africa thanks to ivory exchange (Schuhmacher 2016a, 173–192, fig. 52; 2017), this is more difficult to assure for the Early Bronze Age. Tombs 2, 8 and 10 of the necropolis of Mers (Tangier, Morocco) and tomb 67 in Aïn Dalia (Tangier) might represent such a local Early Bronze Age elite (Schuhmacher 2016a, 194–201), but all the tombs of these necropolis are very poorly provided with grave goods, so a social differentiation is not easily detectable. The mentioned metal axes, on the other hand, are mostly single finds without any context, although some of them could in fact have formed part of elite burials, for example the one from Lamoricière (Oran), which was found in a cave together with flint objects and human bones. It has also to be highlighted that substantial data regarding the supposed pithos burials of Zemamra is missing.

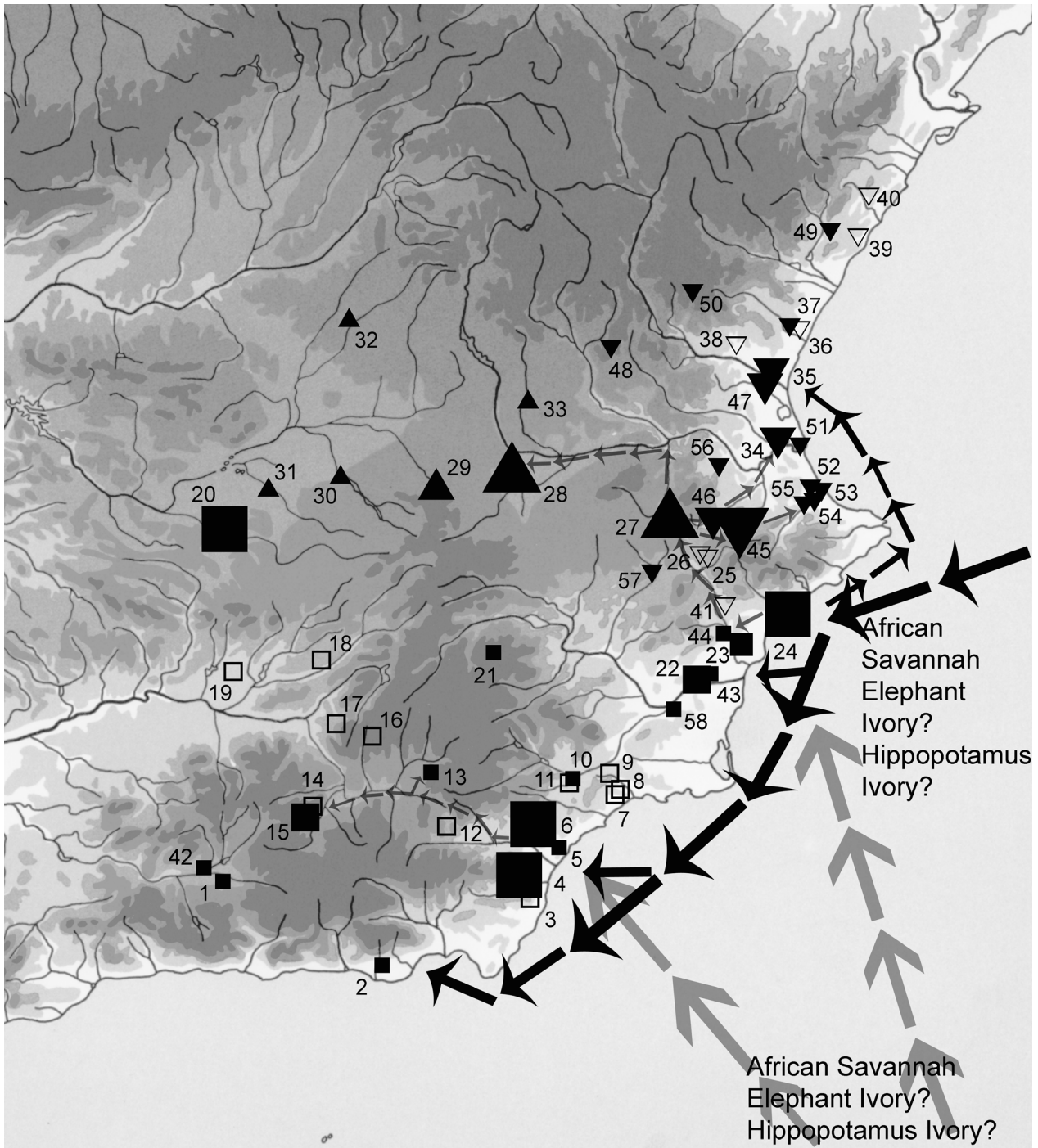


Fig. 5. Routes of exchange in the southeastern Iberian Peninsula during the Younger Early Bronze Age (approx. 2000/1900–1650 BC). The finds, which only can be dated to the Early Bronze Age in general, are also mapped. Ivory objects by number (filled symbols) against sites and contexts dated by radiocarbon (empty symbols) and their cultural assignment. ■ El Argar culture, ▼ Bronze Valenciano, ▲ Bronze Age of La Mancha. 1 Cerro de la Encina; 2 Cerrillo de Ciavieja; 3 Gatas; 4 El Argar; 5 El Oficio; 6 Fuente Álamo; 7 Zapata; 8 Cabezo Negro; 9 La Ceñuela; 10 Los Cipreses; 11 Lorca: city centre; 13 Cerro de la Virgen; 12 El Picacho; 14 Cerro de los Castellones; 15 Las Peñuelas; 16 Castellón Alto; 17 Terrera del Reloj; 18 Rincón de Olvera; 19 Peñalosa; 20 Cerro de la Encantada; 21 Cerro de las Víboras; 22 San Antón; 23 Caramoro I; 24 Illeta dels Banyets; 25 Barranco Tuerto; 26 Cabezo Redondo; 27 Cerro del Cuchillo; 28 El Acequión; 29 El Quintanar; 30 Sta. María del Retamar; 31 El Azuer; 32 Cueva del Fraile; 33 Cerro del Cuco; 34 Muntanya Assolada; 35 Lloma de Betxi; 36 Pic dels Corbs; 37 Les Raboses; 38 Puntal dels Llops; 39 Orpesa la Vella; 40 Mas d'Abad; 41 Lloma Redona; 42 Cerro de los Infantes; 43 Laderas del Castillo; 44 El tabaià; 45 Mola d'Agres; 46 Cabezo del Navarro; 47 Muntanyeta de Cabrera; 48 El Picarcho; 49 Cova de Dalt del Tossal de la Font; 50 Peña de la Dueña; 51 Covacha de His und Covacha Giner; 52 Cova del Cingle; 53 El Pla; 54 Cova de la Solana de l'Almuixich; 55 Cova del Racó del Duc; 56 Altico de la Hoya; 57 Cerro de la Campana; 58 Puntarrón Chico.

Discussion

In the current state of investigation, it seems that during the Early Bronze Age (ca. 2250–1650 BC) ivory objects were only present in the southeastern quarter of the Iberian Peninsula and the Balearic Islands (Schuhmacher 2012a, 362–364, 429–437, fig. 104, 106–107, 110, 157–158). Until now, not one single object made of ivory and dated to that time period has been detected, neither in Portugal nor in the Spanish southwest. Although this data has to be relativised, as the first stages of the Early Bronze Age in these areas are still not well known or are represented by transitional and poorly defined complexes, as are the Ferradeira and Montelavar horizons (Mataloto et al. 2013; Cardoso 2014/2015, 285 f., 300–303). Therefore, in many cases it is difficult to decide whether some objects belong to a Final Chalcolithic/Bell Beaker period or to the Early Bronze Age phase. So, it is possible that the Bell Beaker or Final Chalcolithic complexes in these regions last longer than in others, until the end of the 3rd mill. BC or the beginning of the 2nd mill. BC. However, not any ivory object from the Bronze del Suroeste/Bronze do Sudoeste, which begins at about 2000 BC, is known.

In the first stage of the Early Bronze Age of the Spanish southeast (ca. 2250–1900 BC), the large majority of ivory objects belong to the El Argar culture (Schuhmacher 2012a, 362–364, 429–437, fig. 104, 106–107, 110). Only occasionally some artefacts reached the Bronze Age of La Mancha or the Valencian Bronze as worked objects through exchange or the movement of people, for example by marriage agreements. In comparison, complete tusks or secondary blocks from African and Asian elephant and hippopotamus were obtained by the El Argar settlements lying in the Almanzora and Segura estuaries and were worked there in workshops, as for example in Fuente Álamo. In a similar manner as during the Final Chalcolithic/Bell Beaker period, ivory still fulfils an important role as prestige good. Even the tombs of a few people buried with a large number of valuable ivory items that served as public symbols and were possibly part of ceremonial dresses have been documented.

During the second stage of the Early Bronze Age (ca. 1900–1650 BC), the situation changed. Now

the Valencian Bronze and possibly also the Bronze Age of La Mancha, actively participated in the exchange of ivory, as the number and weight of ivory objects documented in these cultural areas increased. At the same time the detection of potential ivory workshops in Mola d'Agres and Muntanyeta Cabrera speaks for the arrival of ivory in the form of complete tusks or secondary blocks at the sites lying near the Turia estuary and other coastal areas. Now, only African elephant and hippopotamus ivory were exchanged with societies living in the region of Oran (Algeria) and the zone between Rabat and Casablanca (Morocco). Although in the tombs of the El Argar culture small ivory objects are still present, mostly buttons and beads, their social value seems to have diminished. This might indicate that they are now only one item among various other prestige objects, mainly items of copper/bronze and silver, and are no longer as decisive for the attribution of a high prestige or status.

Conclusion

During the Early and Middle Chalcolithic extraordinary objects made of ivory can be found in the Dolmen de Montelirio, as well as in tomb 10049 (both Valencina de la Concepción), and in both cases the majority of the grave goods belong to one or only a few individuals (Schuhmacher 2017). Therefore, it might be possible to identify a first notion of individuality, a change from a segmented society to one with an emerging elite with high prestige and power (García Sanjuán 2006, 157; Cruz-Auñón/Mejías 2013, 196 f.). But mostly, exemplified through the tombs of Los Millares or tombs 1 and 2 of Perdigões, this is more difficult to determine as it seems to be camouflaged under the guise of collective burial rituals (Schuhmacher 2017), being not possible to differentiate the diverse inhumations and their corresponding grave goods. Clearly these personalities are the beneficiaries of the exchange of ivory and other exotic goods enriching their prestige and power. Ivory could be the only element differentiating these burials from the rest, for example in the case of the burials in the corridor of tomb 40 of Los Millares, or as in the Dolmen de Montelirio and tomb 10049 of Valencina de la Concepción, which could be

part of a whole assemblage of goods, among them various imported ones, together with objects of non-local flint, amber, variscite or cinnabar. At the same time, it is striking that during the Early and Middle Chalcolithic ivory is mostly employed for objects which seem to form part of ceremonial outfits with decorative combs and pins, bracelets, non-functional but showy rock crystal daggers with ivory hilts or maybe ritual objects such as anthropomorphic and zoomorphic statuettes (idols?) (Schuhmacher 2012a; García Sanjuán et al. 2013). This could be explained by the fact that the ivory exchange was not meant to create individual enrichment but collective wealth and at the same time increased the prestige of the people who were involved and organised the exchange, expressed by ivory objects as public symbols (compare Risch 2018, 55–65). At the same time the number of metal objects in tombs is very low during this time period (García Sanjuán 2013, 43–46; García Sanjuán et al. 2013).

Metal is not used as a marker of status or prestige. Although it has to be taken in mind that the election of grave goods is determined by social, ritual or religious standards, there are two possible but contradicting explanations for this fact. One is that the scope of metal production in the Early and Middle Chalcolithic was very low and of very reduced economic and social importance, as metal objects are rare in Chalcolithic sites in general, not only in tombs (see Costa Caramé 2013).

The other explanation is just the opposite: copper objects were produced in relatively large quantities and almost exclusively in form of functional objects such as awls, saws, axes and maybe ingots in form of axes for the exchange. Metal objects, among them also possible axe ingots, although rarely in tombs, and metallurgical activities are documented in the most important Chalcolithic sites, such as Valencina de la Concepción, Los Milares, Zambujal and so on (García Sanjuán 2013, 43–46; Gauß 2015, 123–138). Nocete and his collaborators postulated a large-scale metallurgical production (Nocete et al. 2008), although their arguments are debatable (García Sanjuán 2013, 43–46).

In any case it is clear that during the Early and Middle Chalcolithic a high status or prestige is marked by exotic objects such as ivory and others (García Sanjuán 2013, 42–50; García Sanjuán et al.

2013). This might indicate the crucial importance of exchange networks and knowledge of foreign lands that these societies had. The fact that the number of metal objects registered in the most important Chalcolithic sites is low and they almost do not appear in tombs might be explained by the importance they had as exchange products (compare Gauß 2015, 227–230). This could be illustrated by the metal objects probably imported into the Magreb from the Iberian Peninsula (Schuhmacher 2017) in exchange for ivory. Since copper was easy to obtain and only used for tools, it was not appreciated in an ideological-social context.

During the Final Chalcolithic/Bell Beaker period, in a similar way as before, a few prominent personalities from a growing elite were allowed a great self-representation with symbolic objects made of ivory and gold, for example in the tomb of Matarrubilla, Los Algarbes tomb 5 and the Funerary Area 2 of Camino de Yeseras (Schuhmacher 2017). These individuals, as in the previous Pre-Beaker Chalcolithic phase, seem to be those who organised the exchange at a long and medium distance. Besides them, a larger group of people benefitted from ivory exchange, possessing a few objects made of ivory, but did not have this exposed social position. A trend of imitation by other groups of individuals, maybe of socially lower prestige, can be observed by using locally available material (*Elephas antiquus* and sperm whale ivory) for the production of ivory objects.

With the beginning of the Early Bronze Age, the situation began to change. Ivory objects in tombs became rarer, although there are still some exceptions like the tomb of Molinos de Papel with a big self-representation of ivory items. At the same time in the El Argar culture, other elements rather than ivory were used to express prestige or status and power, copper weapons, gold objects, special ceramic vessels (Lull et al. 2011). This is an evolution that maybe already started in the Final Chalcolithic as some tombs, like tombs 1 and 4 of Humanejos, might indicate (García Sanjuán et al. 2018; Garrido Pena et al. 2019).

This evolution continued into the Younger Early Bronze Age. The number of tombs which contain ivory objects is low, which indicates the high value of ivory. But it is also clear that ivory alone no longer seems to be an indicator of

social status, while it is the combination of ivory with other elements that takes its place. In fact, the presence of ivory is often restricted to some buttons or beads besides gold or silver objects, swords, halberds or diadems. Thus, there is a clear change in the perception and social value of ivory. As had previously happened during the Older Early Bronze Age, metal objects were placed in the tombs mainly in the form of weapons or elements of self-representation such as silver diadems, as well as gold bracelets and ornaments. Prestige or rank is not achieved and expressed by exotic objects obtained by exchange, maybe even the importance of long and middle range exchange as a whole diminished during this period. The importance of metal weapons in the tombs and the loss of importance of ivory objects highlights a profound change in the Early Bronze Age society of the El Argar culture, where the figure of the warrior and his family achieved a special importance and occupied the highest scale of society (Horn/Kristiansen 2018). This is not as clearly visible in

La Mancha and the Valencian Bronze Age, where documented tombs as a whole are less numerous and show fewer grave goods. Therefore, it cannot really be decided whether in La Mancha and the area of the Valencian Bronze the evolution was similar, or on the contrary ivory still had its importance as social marker, as might be indicated by the high gross weight of identified ivory objects in La Mancha Bronze Age. But for the El Argar culture the evolution seems to be clear, the social value of ivory changed in accordance with the evolution of Bronze Age society and the birth of the warrior.

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Bibliography

- Ayala 1991*: M. M. Ayala Juan, El poblamiento argárico en Lorca. Estado de la cuestión (Murcia 1991).
- Banerjee et al. 2011a*: A. Banerjee/W. Dindorf/A. Mikdad/T. Reischmann/T. X. Schuhmacher, Die Elfenbeinfunde aus Kef-el-Baroud (Ziaïda, Ben Slimane, Marokko) und die Frage des Nordafrikanischen Elefanten. *Madriider Mitteilungen* 52, 2011, 113–138.
- Banerjee et al. 2011b*: A. Banerjee/A. El Khayari/D. Marzoli/J. Eiwanger/F. Enzmann/J. Goebbels/P. M. Grootes/J. Huth/M. Hüls/D. Meinel/J. Michel/M.-J. Nadeau/T. Reischmann/J.-O. Schwarz, Naturwissenschaftliche Untersuchungen zum Elfenbein von Sidi Harraz/Cap Sim und Mogador (Essaouira, Marokko). *Madriider Mitteilungen* 52, 2011, 87–138.
- Banerjee et al. 2017*: A. Banerjee/T. X. Schuhmacher/J. L. Cardoso/J. L. López Castro/A. Ferjaoui/A. Mederos Martín/V. Martínez Hahn Müller/I. Ben Jerbania, Marfil de hipopótamo procedente de estratos fenicios arcaicos en Utica (Túnez). *Madriider Mitteilungen* 58, 2017, 80–105.
- Belmonte/López Padilla 2006*: D. Belmonte Mas/J. A. López Padilla, Productos, desechos y áreas de actividad en la Illeta dels Banyets de El Campello (ca. 1900–ca. 1400 ANE). Actuaciones de 2000–2001. In: J. A. Soler Díaz (ed.), *La ocupación prehistórica de la Illeta dels Banyets* (El Campello, Alicante) (Alicante 2006) 173–208.
- Benítez de Lugo et al. 2007*: L. Benítez de Lugo Enrich/H. J. Álvarez García/M. Molina Cañadas/J. Moraleda Sierra, Consideraciones acerca del Bronce de La Mancha a partir de la investigación en la cueva prehistórica fortificada de Castillejo del Bonete (Terrinches, Ciudad Real). Campañas 2003–2005. In: J. M. Millán Martínez/C. Rodríguez Ruza (eds.), *Arqueología de Castilla-la Mancha, Actas de las I Jornadas*, Cuenca 2005 (Cuenca 2007) 231–262.

- Benítez de Lugo et al. 2015*: L. Benítez de Lugo Enrich/T. X. Schuhmacher/N. Palomares Zumajo/H. J. Álvarez García/E. Mata Trujillo/J. Moraleda Sierra/G. Menchén Herreros, Marfil para los muertos en la Cultura de las Motillas. Los botones de Castillejo del Bonete (Terrinches, Ciudad Real). *Madrider Mitteilungen* 56, 2015, 40–61.
- Brandherm 2017*: D. Brandherm, Archäologische Periodisierungskonzepte zwischen materieller Kultur und gesellschaftlicher Entwicklung. Die Fallbeispiele El Argar- und westliche Urnenfelderkultur im Vergleich. In: D. Brandherm/B. Nessel (eds.), *Phasenübergänge und Umbrüche im bronzezeitlichen Europa*. Beiträge zur Sitzung der Arbeitsgemeinschaft Bronzezeit auf der 80. Jahrestagung des Nordwestdeutschen Verbandes für Altertumsforschung. *Universitätsforschungen zur Prähistorischen Archäologie* 297 (Bonn 2017) 25–54.
- Cardoso 2014/2015*: J. Cardoso, The Bell-Beaker Complex in Portugal. An Overview. *O Arqueólogo Português*, série V.4/5, 2014/2015, 275–308.
- Collantes 1969*: F. Collantes de Terán, El dolmen de Matarubilla. In: *Tartessos y sus problemas*. V Symposium Internacional de Prehistoria Peninsular, Jerez de la Frontera 1968 (Barcelona 1969) 47–61.
- Costa Caramé 2013*: M. E. Costa Caramé, La actividad metalúrgica en Valencina de la Concepción (Sevilla). Problemática y situación actual de investigación. In: L. García Sanjuán/J. M. Vargas Jiménez/V. Hurtado Pérez/T. Ruiz Moreno/R. Cruz-Auñón Briones (eds.), *El Asentamiento Prehistórico de Valencina de la Concepción (Sevilla)*. Investigación y Tutela en el 150 Aniversario del Descubrimiento de La Pastora (Sevilla 2013) 459–468.
- Cruz-Auñón/Mejías 2013*: R. Cruz-Auñón Briones/J. C. Mejías García, Diversidad de prácticas funerarias e identidades en el asentamiento de Valencina de la Concepción Sevilla. In: L. García Sanjuán/J. M. Vargas Jiménez/V. Hurtado Pérez/T. Ruiz Moreno/R. Cruz-Auñón Briones (eds.), *El Asentamiento Prehistórico de Valencina de la Concepción (Sevilla)*. Investigación y Tutela en el 150 Aniversario del Descubrimiento de La Pastora (Sevilla 2013) 175–199.
- Delibes et al. 1998*: G. Delibes/A. Viné/M. Salvador, Santioste, una factoría salinera de los inicios de la Edad del Bronce en Otero de Saregos (Zamora). In: G. Delibes (ed.), *Minerales y metales en la prehistoria reciente*. Algunos testimonios de su explotación y laboreo en la Península Ibérica. *Studia Archaeologica* 88 (Valladolid 1998) 155–197.
- Eiroa 1998*: J. J. Eiroa, Dataciones absolutas del Cerro de las Víboras de Bajil (Moratalla, Murcia). *Quaderns de Prehistoria i Arqueologia de Castelló* 19, 1998, 131–152.
- Earle 1997*: T. Earle, *How Chiefs Come to Power. The Political Economy in Prehistory* (Stanford 1997).
- García Jiménez et al. 2011*: I. García Jiménez/V. Castañeda Fernández/F. Prados Martínez, La necrópolis de cuevas artificiales de Los Algarbes, Tarifa (Cádiz). Nuevas explicaciones históricas a raíz de las actuales investigaciones. In: *Memorial Luis Siret. I Congreso de Prehistoria de Andalucía, La tutela del patrimonio prehistórico* (Sevilla 2011) 583–586.
- García Rivero/Escacena Carrasco 2015*: D. García Rivero/J. L. Escacena Carrasco, Del Calcolítico al Bronce antiguo en el Guadalquivir inferior. El Cerro de San Juan (Coria del Río, Sevilla) y el ‘modelo de reemplazo’. *Zephyrus* 76, 2015, 15–38.
- García Sanjuán 2006*: L. García Sanjuán, Funerary Ideology and Social Inequality in the Late Prehistory of the Iberian South-West (c. 3300–850 calBC). In: P. Díaz-del-Río/L. García-Sanjuán (eds.), *Social Inequality in Iberian Late Prehistory*. *British Archaeological Reports. International Series* 1525 (Oxford 2006) 149–169.
- García Sanjuán 2013*: L. García Sanjuán, El asentamiento de la Edad del Cobre de Valencina de la Concepción. Estado actual de la investigación, debates y perspectivas. In: L. García Sanjuán/J. M. Vargas Jiménez/V. Hurtado Pérez/T. Ruiz Moreno/R. Cruz-Auñón Briones (eds.), *El Asentamiento Prehistórico de Valencina de la Concepción (Sevilla)*. Investigación y Tutela en el 150 Aniversario del Descubrimiento de La Pastora (Sevilla 2013) 21–59.

- García Sanjuán et al. 2013*: L. García Sanjuán/M. Lucíañez Triviño/T. X. Schuhmacher/D. Wheatley/A. Banerjee, Ivory Craftsmanship, Trade and Social Significance in the Southern Iberian Copper Age. The Evidence from the PP4–Montelirio Sector of Valencina de la Concepción (Seville, Spain). *European Journal of Archaeology* 16.4, 2013, 610–635.
- García Sanjuán et al. 2018*: L. García Sanjuán/M. Cintas-Peña/M. Bartelheim/M. Lucíañez Triviño, Defining the ‘Elites’. A Comparative Analysis of Social Ranking in Copper Age Iberia. In: H. Meller/D. Gronenborn/R. Risch (eds.), *Überschuss ohne Staat. Politische Formen in der Vorgeschichte. Surplus without State. Political Forms in Prehistory*. 10. Mitteldeutscher Archäologentag vom 12. bis 21. Oktober 2017 in Halle (Saale). *Tagungen des Museums für Vorgeschichte Halle 18 (Halle 2018)* 311–333.
- Garrido Pena et al. 2019*: R. Garrido Pena/R. Flores Fernández/A. M. Herrero Corral, Las sepulturas campaniformes de Humanejos (Parla, Madrid) (Madrid 2019).
- Gauß 2015*: R. Gauß, Zambujal und die Anfänge der Metallurgie in der Estremadura (Portugal). *Technologie der Kupfergewinnung, Herkunft des Metalls und soziokulturelle Bedeutung der Innovation*. *Iberia Archaeologica* 15.1 (Tübingen 2015).
- Horn/Kristiansen 2018*: C. Horn/K. Kristiansen, Introducing Bronze Age Warfare. In: C. Horn/K. Kristiansen (eds.), *Warfare in Bronze Age Society* (Cambridge 2018) 1–15.
- Liesau 2016*: C. Liesau von Lettow-Vorbeck, Some Prestige Goods as Evidence of Interregional Interactions in the Funerary Practices of the Bell Beaker Groups of Central Iberia. In: E. Guerra Doce/C. Liesau von Lettow-Vorbeck (eds.), *Analysis of the Economic Foundations Supporting the Social Supremacy of the Beaker Groups*. *Proceedings of the XVII UISPP World Congress*, 1.–7. September 2014. Burgos 6. Session B36 (Oxford 2016) 69–93.
- Liesau/Blasco 2019*: C. Liesau von Lettow-Vorbeck/C. Blasco, Botones y cuentas campaniformes en la región de Madrid. ¿Meros adornos o la exclusividad del prestigio? In: G. Delibes/E. Guerra (eds.), *¡Un Brindis por el Príncipe! El vaso campaniforme en el interior de la Península Ibérica (2500–2000 a.C.)*. *Museo Arqueológico Regional de Madrid 1* (Madrid 2019) 127–149.
- Liesau/Schuhmacher 2012*: C. Liesau von Lettow-Vorbeck/T. X. Schuhmacher, Un taller de marfil del Bronce argárico en el yacimiento de Fuente Álamo (Cuevas del Almanzora, Almería). In: A. Banerjee/J. A. López Padilla/T. X. Schuhmacher (eds.), *Marfil y Elefantes en la Península Ibérica y el Mediterráneo*. *Internationale Tagung Museo Arqueológico de Alicante*, 26.–27. November 2008. *Iberia Archaeologica* 16.1 (Darmstadt 2012) 121–138.
- Liesau et al. 2008*: C. Liesau von Lettow-Vorbeck/C. Blasco/P. Ríos/J. Vega/R. Menduñía/J. F. Blanco/J. Baeña/T. Herrera/A. Petri/J. L. Gómez, Un espacio compartido por vivos y muertos. El poblado calcolítico de fosos de Camino de Yeseras (San Fernando de Henares, Madrid). *Complutum* 19, 2008, 97–120.
- Liesau et al. 2011*: C. Liesau von Lettow-Vorbeck/A. Banerjee/J.-O. Schwarz, Camino de las Yeseras’ Ivory Collection. *Advances in Analysis Technology Used in Identifying Raw Material*. In: C. Blasco/C. Liesau von Lettow-Vorbeck/P. Ríos (eds.), *Yacimientos calcolíticos con campaniforme de la región de Madrid. Nuevos estudios*. *Patrimonio Arqueológico de Madrid 6* (Madrid 2011) 381–386.
- Lillios 2020*: K. Lillios, *The Archaeology of the Iberian Peninsula. From the Palaeolithic to the Bronze Age* (Cambridge 2020).
- López Padilla 2006*: J. A. López Padilla, Distribución territorial y consumo de botones de perforación en “V” en el ámbito argárico. *Trabajos de Prehistoria* 63.2, 2006, 1–25.
- López Padilla et al. 2006*: J. A. López Padilla/D. Belmonte Mas/M. P. de Miguel Ibañez, Los enterramientos argáricos de la Illeta dels Banyets de El Campello. *Prácticas funerarias en la frontera oriental de El Argar*. In: J. A. Soler Díaz (ed.), *la ocupación Prehistórica de la Illeta dels Banyets (El Campello, Alicante)* (Alicante 2006) 119–171.

- Luciañez Triviño 2018*: M. Luciañez Triviño, El marfil en la Edad del Cobre de la Península Ibérica. Una aproximación tecnológica, experimental y contextual a las colecciones ebúrneas del mega-sitio de Valencina de la Concepción-Castilleja de Guzmán (Sevilla) (PhD-Thesis Universidad de Sevilla 2018).
- Lull 2000*: V. Lull, Argaric Society. Death at Home. *Antiquity* 74, 2000, 581–590.
- Lull/Estévez 1986*: V. Lull/J. Estévez, Propuesta metodológica para el estudio de las necrópolis argaricas. In: Consejería de Cultura de la Junta de Andalucía (ed.), Homenaje a Luis Siret (1934–1984) (Sevilla 1986) 441–452.
- Lull et al. 2011*: V. Lull/R. Micó/C. Rihuete Herrada/R. Risch, El Argar and the Beginning of Class Society in the Western Mediterranean. In: S. Hansen/J. Müller (eds.), Sozialarchäologische Perspektiven. Gesellschaftlicher Wandel 5000–1500 v. Chr. zwischen Atlantik und Kaukasus. Internationale Tagung 15.–18. Oktober 2007 in Kiel. *Archäologie in Eurasien* 24 (Darmstadt 2011) 381–414.
- Lull et al. 2015*: V. Lull/R. Micó/C. Rihuete/R. Risch, Transition and Conflict at the End of the 3rd Millennium BC in South Iberia. In: H. Meller/H. Wolfgang Arz/R. Jung/R. Risch (eds.), 2200 BC – Ein Klimasturz als Ursache für den Zerfall der Alten Welt? – A Climatic Breakdown as a Cause for the Collapse of the Old World? 7. Mitteldeutscher Archäologentag. Tagungen des Landesmuseums für Vorgeschichte Halle 12.1/2 (Halle 2014) 365–407.
- Marín et al. 2012*: J. M. Marín/J. A. López Padilla/M. P. de Miguel Ibañez, Un excepcional ajuar ebúrneo de los inicios de la Edad del Bronce en Los Molinos de Papel (Carvaca de la Cruz, Murcia). In: D. Marzoli/J. A. López Padilla/T. X. Schuhmacher (eds.), Marfil y Elefantes en la Península Ibérica y el Mediterráneo. Internationale Tagung Museo Arqueológico de Alicante, 26.–27. November 2008. *Iberia Archaeologica* 16.1 (Darmstadt 2012) 157–171.
- Mata 1993*: E. Mata Almonte, Informe sobre la intervención en el yacimiento de Los Algarbes, Tarifa (Cadiz). Campaña 1990. *Anuario Arqueológico de Andalucía* 1991.III, 1993, 583–593.
- Mataloto et al. 2013*: R. Mataloto/J. M. Matos Martins/A. M. Monge Soares, Cronologia absoluta para o Bronze do Sudoeste. Periodização, base de dados, tratamento estatístico. *Estudos Arqueológicos de Oeiras* 20, 2013, 303–338.
- Mederos 2020*: A. Mederos, De vuelta al Mediterráneo. Los contactos e intercambios del Sur de la Península Ibérica durante el Campaniforme y El Argar con el Egeo y Levante (2500–1660 AC). *Estudos Arqueológicos de Oeiras* 27, 2020, 197–280.
- Molina et al. 2017*: F. Molina González/J. A. Cámara Serrano/A. Dorado Alejos/M. Villarroya Arín, El fenómeno campaniforme en el Sudeste de la Península Ibérica. El caso del Cerro de la Virgen (Orce, Granada). In: V. S. Gonçalves (ed.), Sinos e taças junto ao oceano e mais longe. Aspectos de presença campaniforme na Península Ibérica. *Estudos e Memórias* 10 (Lisboa 2017) 258–275.
- Monteagudo 1977*: L. Monteagudo, Die Beile auf der Iberischen Halbinsel. *Prähistorische Bronzefunde* 9.6 (München 1977).
- Morillo 2015*: J. M. Morillo León, On-Field Characterization of Late-Prehistoric Mediterranean Ivories with Portable Instruments and Noninvasive Techniques (Master Thesis Università La Sapienza di Roma 2015).
- Morillo et al. 2018*: J. M. Morillo León/C. Pau/J. Guilaine, Los objetos de adorno en marfil de proboscídeos del hipogeo de Padru Jossu (Sanluri, Cerdeña, Italia) y el Campaniforme mediterráneo. *Zephyrus* 82, 2018, 35–63.
- Müller-Kissing 2017*: M. Müller-Kissing, Neue Aspekte zur chronologischen Entwicklung der El Argar-Kultur im Becken von Vera (Südostspanien). In: D. Brandherm/B. Nessel (eds.), Phasenübergänge und Umbrüche im bronzezeitlichen Europa, Beiträge zur Sitzung der Arbeitsgemeinschaft Bronzezeit auf der 80. Jahrestagung des Nordwestdeutschen Verbandes für Altertumsforschung. *Universitätsforschungen zur Prähistorischen Archäologie* 297 (Bonn 2017) 199–214.

- Nocete et al. 2008*: F. Nocete/G. Queipo/R. Sáez/J. M. Nieto/N. Inácio/M. R. Bayona/A. Peramo/J. M. Vargas/R. Cruz-Auñón/J. I. Gil-Ibarguchi/J. F. Santos, The Smelting Quarter of Valencina de la Concepción (Seville, Spain). The Specialized Copper Industry in a Political Centre of the Guadalquivir Valley during the Third Millennium BC (2750–2500 BC). *Journal of Archaeological Science* 35, 2008, 717–732.
- Nocete et al. 2013*: F. Nocete/J. M. Vargas/T. X. Schuhmacher/A. Banerjee/W. Dindorf, The Ivory Workshop of Valencia de la Concepción (Seville, Spain) and the Identification of Ivory from Asian Elephant on the Iberian Peninsula in the first half of the 3rd Millennium B.C. *Journal of Archaeological Science* 40, 2013, 1579–1592.
- Obermaier 1919*: H. Obermaier, El dolmen de Matarubilla (Madrid 1919).
- Olalde et al. 2019*: I. Olalde et al., The Genomic History of the Iberian Peninsula over the Past 8000 Years. *Science* 363, 2019, 1230–1234.
- Pau et al. 2018*: C. Pau/J. M. Morillo León/J. A. Cámara Serrano/F. Molina González, Los objetos de adorno en marfil del yacimiento del Cerro de la Virgen (Orce, Granada). *Complutum* 29.2, 2018, 267–298.
- Pfälzner 2013*: P. Pfälzner, The Elephant Hunters of Bronze Age Syria. In: J. Aruz/S. B. Graff/Y. Rakic (eds.), *Cultures in Contact from Mesopotamia to the Mediterranean in the Second Millennium B.C.* (New York 2013) 112–131.
- Posac 1975*: C. Posac Mon, Los Algarbes (Tarifa). Una necrópolis de la Edad del Bronce. *Noticiario Arqueológico Hispano, Prehistoria* 4, 1975, 87–119.
- Pons 1999*: G. Pons i Homar, Anàlisi espacial del poblament al Pretalaiòtic Final i al Talaiòtic I de Mallorca. *Col·lecció la Deixa* 2 (Palma de Mallorca 1999).
- Ramos et al. 2008*: J. Ramos/M. Zouak/D. Bernal/B. Raissouni (eds.), *Las ocupaciones humanas de la cueva de Caf Taht el Ghar (Tetuán)*. Colección de Monografías del Museo Arqueológico de Tetuán 1 (Cádiz 2008).
- Risch 2018*: R. Risch, Affluent Societies of Later Prehistory. In: H. Meller/D. Gronenborn/R. Risch (eds.), *Überschuss ohne Staat. Politische Formen in der Vorgeschichte. Surplus without State. Political Forms in Prehistory*. 10. Mitteldeutscher Archäologentag vom 12. bis 21. Oktober 2017 in Halle (Saale). *Tagungen des Museums für Vorgeschichte Halle* 18 (Halle 2018) 45–65.
- Rivero 1988*: E. Rivero Galán, Análisis de las Cuevas Artificiales en Andalucía y Portugal (Sevilla 1988).
- Schubart/Ulreich 1991*: H. Schubart/H. Ulreich, Die Funde der Südostspanischen Bronzezeit aus der Sammlung Siret. *Madrider Beiträge* 17 (Mainz am Rhein 1991).
- Schüle 1980*: W. Schüle, Orce und Galera. Zwei Siedlungen aus dem 3. bis 1. Jahrtausend v. Chr. im Südosten der Iberischen Halbinsel (Mainz am Rhein 1980).
- Schuhmacher 2011*: T. X. Schuhmacher, Elfenbein des Chalkolithikums und der Frühen Bronzezeit auf der Iberischen Halbinsel. Ergebnisse eines Interdisziplinären Forschungsprojekts. In: A. Banerjee/C. Eckmann (eds.), *Elfenbein und Archäologie. INCENTIVS-Tagungsbeiträge 2004–2007*. Römisch-Germanisches Zentralmuseum – Tagungen 7 (Mainz am Rhein 2011) 91–122.
- Schuhmacher 2012a*: T. X. Schuhmacher, Die Elfenbeinobjekte des Chalkolithikums und der Frühen Bronzezeit auf der Iberischen Halbinsel. *Interdisziplinäre Studien zu Herkunft, Austausch, Verarbeitung und sozialer Bedeutung von Elfenbein*. *Iberia Archaeologica* 16.2 (Darmstadt 2012).
- Schuhmacher 2012b*: T. X. Schuhmacher, El marfil en España desde el Calcolítico al Bronce antiguo. Resultados de un proyecto de investigación interdisciplinar. In: A. Banerjee/J. A. López Padilla/T. X. Schuhmacher (eds.), *Marfil y Elefantes en la Península Ibérica y el Mediterráneo*. *Internationale Tagung Museo Arqueológico de Alicante*, 26.–27. November 2008. *Iberia Archaeologica* 16.1 (Darmstadt 2012) 45–68.

- Schuhmacher 2016a*: T. X. Schuhmacher, Elefanten und Elfenbein auf der Iberischen Halbinsel und in Nordwest-Afrika. Interdisziplinäre Studien zu Austauschsystemen im 3. und der ersten Hälfte des 2. Jts. v. Chr. *Iberia Archaeologica* 16.3 (Tübingen 2016).
- Schuhmacher 2016b*: T. X. Schuhmacher, Elfenbein des Chalkolithikums und der Frühen Bronzezeit auf der Iberischen Halbinsel und im Maghreb. Die Ergebnisse eines interdisziplinären Forschungsprojekts. *Madrider Mitteilungen* 57, 2016, 1–58.
- Schuhmacher 2017*: T. X. Schuhmacher, Ivory Exchange Networks in the Chalcolithic of the Western Mediterranean. In: M. Bartelheim/P. Bueno Ramírez/M. Kunst (eds.), *Key Resources and Socio-Cultural Developments in the Iberian Chalcolithic*. *RessourcenKulturen* 6 (Tübingen 2017) 291–312.
- Schuhmacher/Banerjee 2019*: T. X. Schuhmacher/A. Banerjee, Botão em marfim de hipopótamo. In: A. Faustino Carvalho (ed.), *Hipogeu campaniforme do Convento do Carmo (Torres Novas)*. *Coleção Estudos e Documentos* 12 (Torres Novas 2019) 136–138.
- Schuhmacher et al. 2013*: T. X. Schuhmacher/A. Banerjee/W. Dindorf/C. Sastri/T. Sauvage, The Use of Sperm Whale Ivory in Chalcolithic Portugal. *Trabajos de Prehistoria* 70, 2013, 185–203.
- Siret/Siret 1887*: H. Siret/L. Siret, *Les premiers Âges du Métal dans le sud-est de l’Espagne* (Brussels 1887).
- Soler 2002*: J. A. Soler Díaz, *Cuevas de inhumación múltiple en la Comunidad Valenciana* (Madrid 2002).
- Souville 1968*: G. Souville, Los monumentos funerarios preislámicos de Marruecos. *Ensayo de clasificación y distribución*. *Ampurias* 30, 1968, 39–61.
- Souville 1986*: G. Souville, Témoignages sur l’Âge du Bronze au Maghreb Occidental. *Comptes Rendus des Séances de l’Académie des Inscriptions et Belles-Lettres* 1986, 97–114.
- Souville 1988*: G. Souville, Les hommes du chalcolithique et du bronze ont traversé le détroit de Gibraltar. In: E. Ripoll Perelló (coord.), *Actas del Congreso Internacional ‘El Estrecho de Gibraltar’*, Ceuta 1987.1 (Madrid 1988) 285–292.
- Ulreich 1991*: H. Ulreich, Die Gräber in El Argar und El Oficio aufgrund ihrer Dokumentation. In: H. Schubart/H. Ulreich (eds.), *Die Funde der Südostspanischen Bronzezeit aus der Sammlung Siret*. *Madrider Beiträge* 17 (Mainz am Rhein 1991) 341–396.
- Valera et al. 2015*: A. C. Valera/T. X. Schuhmacher/A. Banerjee, Ivory in the Chalcolithic Enclosure of Perdigões (South Portugal). *The Social Role of an Exotic Raw Material*. *World Archaeology* 47.3, 2015, 390–413.
- Vila 2015*: E. Vila, The ‘Syrian Elephant’ Revisited. Analysis of the Elephant Bones at Mishrife/Qatna in Late Bronze Age Syria. In: P. Pfälzner/M. Al-Maqdissi (eds.), *Qatna and the Networks of Bronze Age Globalism*. *Proceedings of an International Conference in Stuttgart and Tübingen in October 2009* (Wiesbaden 2015) 487–496.

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Pottery Production Strategies in the Upper Guadalquivir Valley during the Middle and Late Bronze Ages of Southern Iberia

The Cases of Peñalosa and Cabezuelos (Jaén, Spain)

Keywords: morphometry, ceramic production, southeastern Iberia, Bronze Age, Peñalosa, Cerro de Cabezuelos

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Abstract

This paper is about the pottery productions from two sites located in the Upper Guadalquivir, studied as a morphometric perspective: the Argaric site of Peñalosa (Baños de la Encina, Jaén, Spain) and the Bronze Age site of Cerro de Cabezuelos (Úbeda, Jaén, Spain). The ideal contextualisation

and dating of the ceramics from these sites will provide a broad perspective on the cultural change between the Middle Bronze Age and the Late Bronze Age in the Upper Guadalquivir valley. Despite the fact that both sites are close and strategically located in the territory, the results obtained from pottery studies have shown that there is no tradition at a formal level in the production of ceramics in this region. Furthermore, from the spatial distribution of the ceramics, different uses of space between the two sites can be observed.

1. Introduction

The use of pottery by the diverse populations, its insertion into the production practices and the important part it played in social reproduction have made it one of the most outstanding elements in the archaeological record. Its abundance is not merely a result of its multiple uses, but also of its resistance to the passage of time (Berducou 1990). These factors have led it to become one of the most studied elements in our discipline and a true chronological and cultural marker.

Its structure makes it a fragile artefact that can be broken relatively easily. This means it has a limited life and its use is restricted to specific activities, although, in some cases, it can be reintroduced in systemic contexts through its reuse as an auxiliary tool in various phases of pottery

production (Hayden/Cannon 1983; Sullivan 1989; Padilla 2018). However, its low production cost, both in terms of human capital and the infrastructure and materials needed to make it, as well as the sources of the raw materials, which are usually found in abundance in the proximity of human settlements, make it an easy-to-acquire artefact.

Its structure, generally in the form of a vessel, appears to have a clear use. It has an eminently functional nature covering a wide range of activities from the most routine daily tasks to others that are exceptional and of a sporadic or circumstantial nature. A vessel is adapted to the functional needs for which it is made. However, this does not mean that it cannot be modified for other uses and even reuses, for which it would be given a specific capacity and form (open or closed) and used as a container for different types of solid or liquid substances. These receptacles were a substantial element of any developed society prior to the industrial revolution, as they facilitated the consumption, processing and storage of foodstuffs.

In addition to the more functional aspects of pottery, it should also be noted that it conveys part of the cultural personality of the group that created it, evidenced, for example, by the selection of a specific decoration and the place it occupied on the vessel. In this respect, pottery decorations reveal an important part of their beliefs, which may or may not be interpretable. This makes it possible to determine the link to a specific cultural or social group, as, for example, has been defined for Bell Beaker decoration (Harrison 1987) or the archaeological identification of the white paste incrustations (Martín/Delibes 1989; Blasco 1994; González Vilchez et al. 1999; Lazarich 1999; Odriozola/Hurtado 2007; Odriozola 2009; Odriozola et al. 2012; Molina et al. 2017).

However, the ceramics also provide an opportunity to hypothesise about the uses of space according to the presence or absence of certain shapes and types of ware and their further functionality. This study presents the results of the morphometric analysis of pottery from the settlements of Peñalosa and Cerro de Cabezuelos (Jaén, Spain) in the Alto Guadalquivir Valley. Statistical techniques are used to obtain well-defined typologies. In the field of pottery studies, statistics has been proved to be particularly useful in

typological analyses, as they serve to demonstrate empirically the diversity of pottery typologies (Lull/Estévez 1986; Orton et al. 1997). The archaeological finds contribute a series of metric variables that, evaluated as a whole, are decisive for establishing differences or similarities among them.

It is important to compare both productions to obtain a broad perspective on the cultural change produced between the two different periods in this area of the Guadalquivir. Thus, these archaeological sites have allowed the creation of a well-defined, dated and contextualised typology of both periods in the aforementioned area.

2. Materials and Methods

With the aim of obtaining a typology for the pottery from the archaeological sites of Peñalosa and Cerro de Cabezuelos, a multivariant statistical analysis has been applied based on the extraction of the main components (ACP). A total of 742 pottery sherds were examined in the case of Peñalosa and 36 in the case of Cerro de Cabezuelos, in order to reconstruct the vessels, pots or individual containers, something that has been made possible thanks by the conservation of at least half of the vessels that included parts indicative of their sizes and shapes (rims, bases, carinations, etc.). The choice of this statistical technique was the result of a series of tests carried out in studies undertaken by the Department of Prehistory at the University of Granada (Esquivel/Contreras 1984; Contreras 1984; 1986; Esquivel et al. 1991; Fernández 2011; Vico 2016; Gámiz 2018). These led to the creation of a systematised statistical analysis methodology applied to the archaeological results for data processing.

ACP is a factorial analysis capable of reducing a large amount of data based on their correlation and the creation of new variables known as factors, with the first three normally containing most of the information (Aranda 2001; Esquivel et al. 1991; Fernández 2011). The variables reduced to factors (rim diameter, total vessel height, maximum width diameter, height from the maximum width, base diameter, diameter of the narrowing, height of the narrowing, upper body angle, lower body angle and rim angle) are based mainly on the



Fig. 1. The archaeological site of Peñalosa and its location in the Iberian Peninsula.

proportions and geometry of the sherd, such as the morphometric values of the pottery (Contreras 1986; Aranda 2001; Fernández 2011; Dorado et al. 2015; Vico 2016; Vico et al. 2018; Gámiz 2018).

The results are shown on a two-dimensional scatter plot based on calculated averages and arranged on a Y and an X axis defined by the components. The points are distributed on the plot according to the morphometric proximity of the vessels, which visually facilitates the grouping of the pottery typologies. The scatter plots have permit to define the different typological groups defined for each site. Within these groups there

are different types and subtypes, for which the conceptual bases previously established in other studies undertaken by the Department of Prehistory and Archaeology (Esquivel/Contreras 1984; Contreras 1984; 1986; Esquivel et al. 1991; Aranda 2001; Fernández 2011; Dorado et al. 2015; Vico 2016; Gámiz 2018) has been followed. The forms were expressed according to the Archaeological Information System of Andalusia (SIIA) codification designed by the University of Granada GEPRAN research group, with the aim of unifying the pottery classification criteria and facilitating comparisons with other ceramological studies.

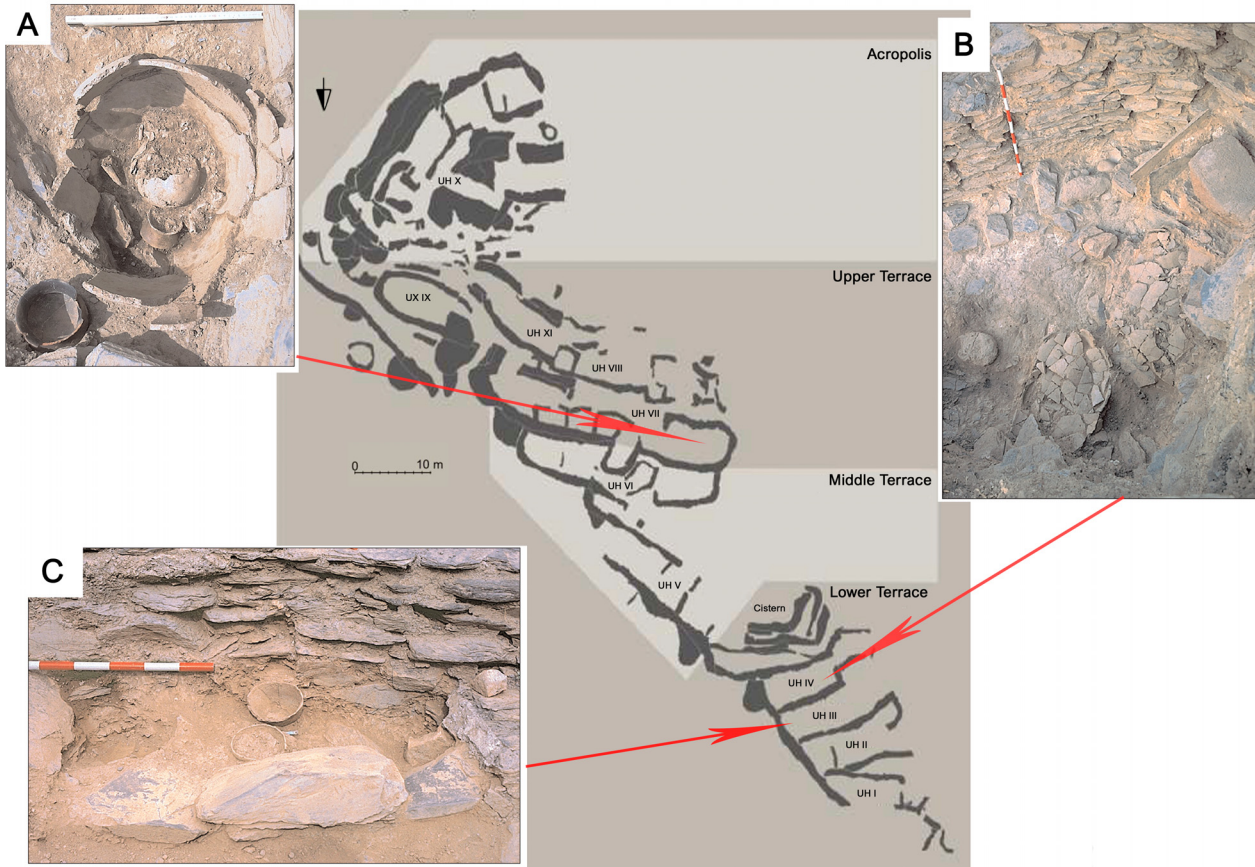


Fig. 2. Distribution of vessels into the archaeological site of Peñalosa. A. pithos burial; B. grinding structures and storage vessels; C. food production and consumption area.

3. The Metallurgical Settlement of Peñalosa (Baños de la Encina, Spain) during the Middle Bronze Age

3.1. Archaeological Excavations, Context and Material Culture

Peñalosa is an Argaric settlement in the municipality of Baños de la Encina (Jaén) in the Sierra Morena mountains. It is associated with the Argaric Culture that developed during the Bronze Age (2200–1500 BC) in the southeastern Iberian Peninsula (*fig. 1*). The archaeological site is located in an area that controlled the communications routes and it would have been the connection between the communities in the centre and south of the Peninsula.

The important presence of metal ore mines (copper and silver) in the area around the archaeological site and the corroboration of their exploitation during the Argaric period (Contreras 2000;

Hunt et al. 2011; Contreras/Moreno 2015) it has allowed to define the archaeological site as an important mining centre, with its main economic activity being metallurgical production. The structure of the Peñalosa settlement is a stratified system built on terraces with the space organised according to the typical characteristics of the Bronze Age in the southeastern Iberian Peninsula (Contreras et al. 2005). It is arranged in four large units the lower, middle and upper terraces and acropolis and is bordered to the east by a fortified wall. Each of the terraces has various habitation units, some of them with graves underneath (Contreras et al. 2005). The good definition of the structures, as well as the excellent conservation of the archaeological record allow to make typological classifications of a very large pottery assemblage. Likewise, the contextualisation of its ceramic assemblage allows to establish formal differences between each of the activities carried out in the settlement (*fig. 2*) (mainly domestic, funerary and metallurgical).

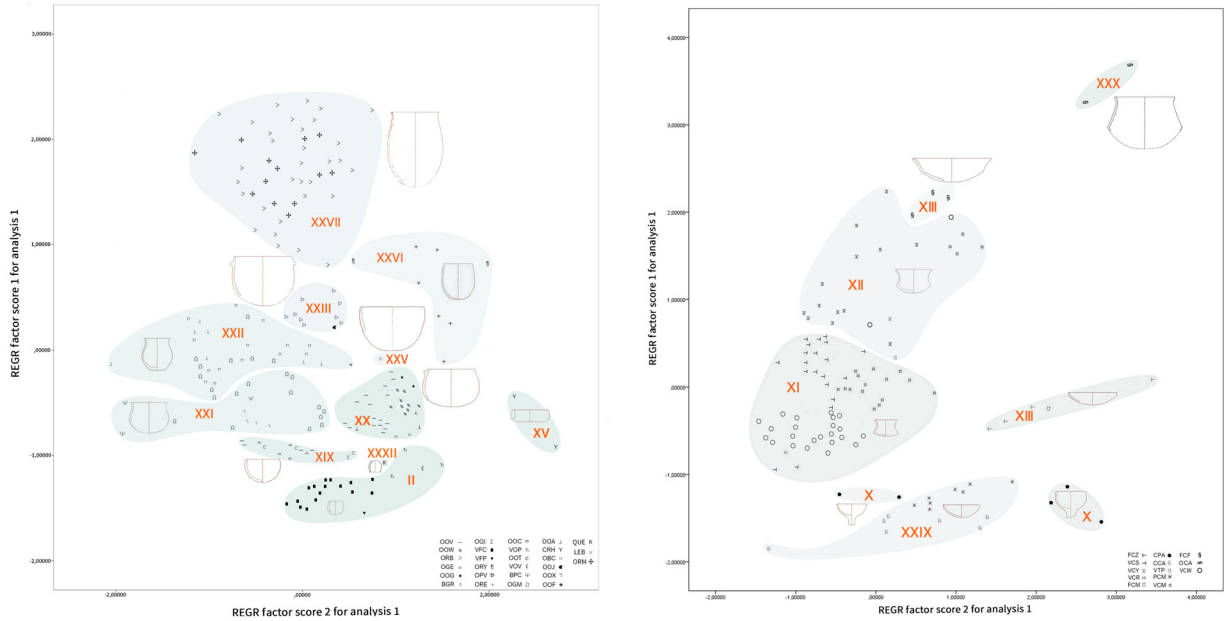


Fig. 3. Diagram with complex shaped vessels.

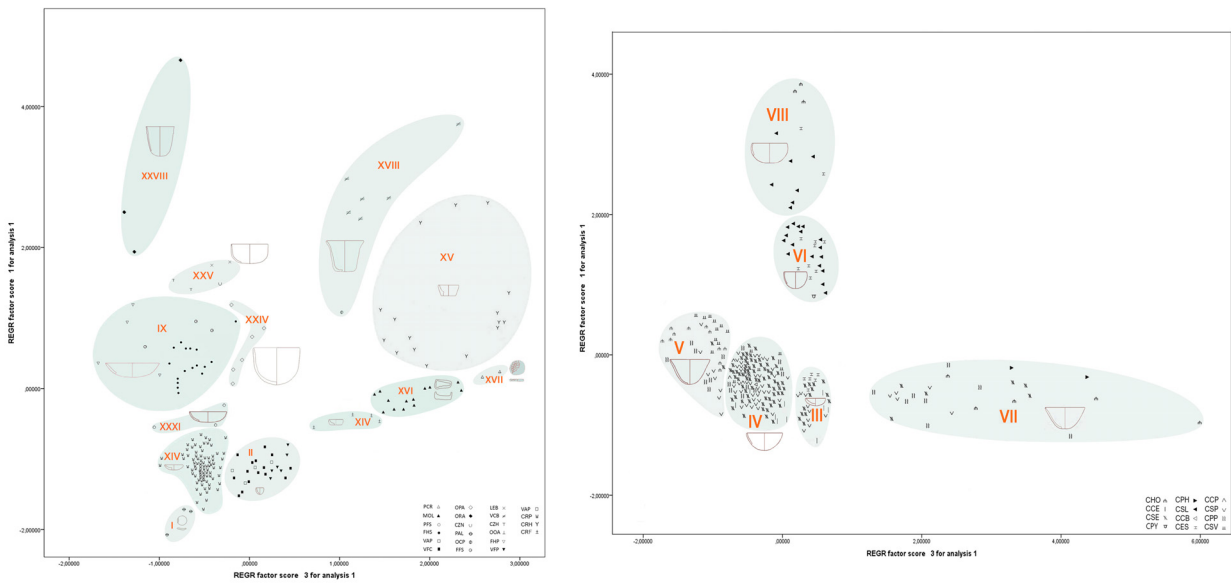


Fig. 4. Diagram with simple shaped vessels.

3.2. The Morphometry of Argaric Pottery

The large amount of data meant that more than one statistical analysis (four in total) had to be carried out, using in each of them those variables that offered optimum combinations of the different typological groups due to their similarity. Two of them were of complex shapes with a maximum diameter produced either by a narrowing of the vessel neck or by very closed rims (fig. 3) or they were carinated bodies (fig. 2). On the other hand,

there were simple shapes without that maximum diameter or narrowing of the vessel that were represented by forms with open rims and walls (fig. 4). Thus, 32 typological groups and 76 types with typical Argaric shapes were obtained that could be put into groups of simple and compound shapes. Of particular note among the simple shapes were the bowls with diverse typologies, both open and closed, as well as simple plates and serving dishes, and pots and ovoid jars with open walls and rims. Of interest among all these simple shapes

were the vessels associated with metallurgical activities, such as crucibles, moulds and perforated sherds that may have been used as heaters (Contreras 2000). Noteworthy as well were particular cases such as a spatula, used as a spoon (Contreras 2000). The group of compound shapes consisted of vessels with middle and lower carinations and cups, all characteristic Argaric shapes. This group also includes other larger forms, such as carinated jars, jars and pots that are either globular or ovoid with a marked or indicated neck, and bottles. An exceptional case is that of a pot for storing cheese with a very incurving rim and a body with globular tendency.

3.3. Pottery Production and Maintenance Activities

The morphometric study created a series of general groupings that allowed to organise all the Peñalosa pottery. Thus, a first assemblage of the vessels used in metallurgy was defined: crucibles, moulds and perforated elements. In those cases, in addition to the presence of a well-defined typology closely related to the processing and smelting of minerals, which has already been demonstrated in other studies (Contreras 2000; Cortés 2007; Contreras/Moreno 2015), there is a series of items that corroborate the use of those vessels for the said activities, among them scorching on the walls and a conspicuous thickness, the result of a crude manufacture (Contreras 2000; Cortés 2007; Contreras/Moreno 2015). The remains of this metallurgical activity have been found in the settlement of Peñalosa, although not all those spaces were used for smelting. Particular areas, such as House VI, have been documented as places where smelting was carried out. However, in most of the houses the mineral would just have been crushed and prepared for smelting, as is shown by the mineral remains found next to grinders used for that purpose (Contreras 2000).

Another group consists of those vessels used for foodstuff processing (pots, casseroles), consumption (bowls, plates, serving dishes) and storage (jars). All the habitat areas excavated to date in Peñalosa have a space dedicated to those types of activities. However, the storage vessels show a

greater concentration in House IV and XVI, where other remains linked to textile weaving were also found (Contreras 2000; Contreras et al. 2014).

In the case of the tombs, a series of pottery grave goods with forms similar to those found in domestic contexts occur, with the difference that they all were subject to meticulous surface treatments, generally polishing. It should be pointed out that in the case of the tombs they are all grave goods, except for the jars or *pithoi*, that were only used as funerary features for infant individuals (Contreras 2000; Alarcón 2010). Neither is pottery used for metallurgy found in these contexts, indicating that only items used for food preparation and consumption were chosen, suggesting a possible ritual purpose.

Finally, there is an outstanding group of ware with uncertain uses. We refer to a series of diminutive vessels that are found in both domestic and funerary contexts. Although their function is not completely clear, their inexpert, non-specialised manufacture and their size have usually led them to be interpreted as having been made by apprentice potters (Bagwell 2002; Alarcón 2010; 2015). Recent analyses have shown them to contain plant or non-ruminating animal residues (García-García 2018).

In addition to the above-mentioned forms, there are others such as loom weights that are sometimes found together with other items, including pin beaters or needles that define areas destined for textile weaving (Contreras 2000; Contreras et al. 2014). These were not included in the morphometric study as their abundance at the archaeological site calls for a specific typological study, although it is necessary to indicate that their presence serves to identify other types of socio-economic activities in this enclave.

4. The Rural Settlement of Cabezuelos (Úbeda, Spain) during the Late Bronze Age

4.1. Archaeological Excavations, Context and Material Culture

El Cerro de Cabezuelos is situated in the municipality of Úbeda (Jaén, Spain) on a marl and limestone promontory overlooking the river Jandulilla valley



Fig. 5. The archaeological site of Cerro de Cabezuelos and its location in the Iberian Peninsula.

in the southern Guadalquivir Basin (*fig. 5*). The settlement is strategically positioned on the summit of a hill with a maximum height of 500m above sea level. It has two slightly raised promontories with a stream bed between them that has been filled with archaeological deposits and material washed down from the higher areas. The highest area is in the southern part and can only be reached by crossing the stream bed, which must have been the reason for the construction of various stretches of defensive wall that would have blocked the way to the upper part of the hill from the more accessible slopes (Dorado et al. 2015; 2020).

The excavations focused on three zones in the northwestern and western of the plateau, where several large trenches were dug that defined the huts and supporting structures and were extended until they reached various stretches of the defensive wall. Another trench was dug in the area where the centre of the habitat is estimated to have been (*fig. 6*). Not only was it possible to analyse the main layout of the settlement, but also the structures that made it up and the movable elements they may have contained. Trenches 2 and 6 correspond to the defensive wall and Trenches 1, 3 and 5 were dug to study the oval huts. Trench 4



Fig. 6. Structures of Cerro de Cabezuelos.

also showed structures in the form of small aligned longitudinal enclosures abutting the hut in Trench 5.

The huts found during the excavation – designated A, B and C – have an oval ground plan and are bordered by plinths of stones of different sizes. All three were delimited by a plinth between 0.30m and 0.50m wide and with a height marked by the stones that made it up, between 0.30m and 0.40m. The plinths consisted of two rows of stones stuck in the ground and an intermediate fill of pebbles or small and medium-sized stones bound together by grey-coloured mud. In some places the plinth was replaced by outcrops of the natural rock against which it was sometimes built. The faces of the best-preserved stretches of plinth have a rough-cast of mud that projects between 5cm and 10cm from the standing stone slabs. Above the basement there would have been a narrow wall of mud and branches; their collapses and those of the roof formed a thin deposit that settled on the earthen floor of the dwellings, filling the area surrounded by the plinths. The impressions in the pieces of mud lead to believe that the elevation above

the foundation would have consisted of a lattice of canes and branches reinforced with wads of hardened mud. The roof, also made of plant matter, would have been supported by sustaining elements such as posts and beams in the interior of the hut; this is shown by the small negative structures documented in the floor of some of them that were reinforced by stones in the form of a wedge. Although the internal division of the habitats is not clear-cut, the find of various elements of mud whitewashed on both sides and not more than 10cm high in the collapse layers could well be an indication of an internal organisation that would have separated the spaces with different uses in a distribution that cannot be defined at present. Some of the stretches of the dwelling wall or its internal constructions – for example in Hut A – were covered with a 3cm thick yellowish stucco that, in some places, has striated geometric decorations. The floors of the dwellings were all made of flattened earth, pebbles bound by mud, or the natural rock cut for that purpose. In the interior there are sometimes areas paved with hardened and burnt mud covered by fine layers of lime, areas that

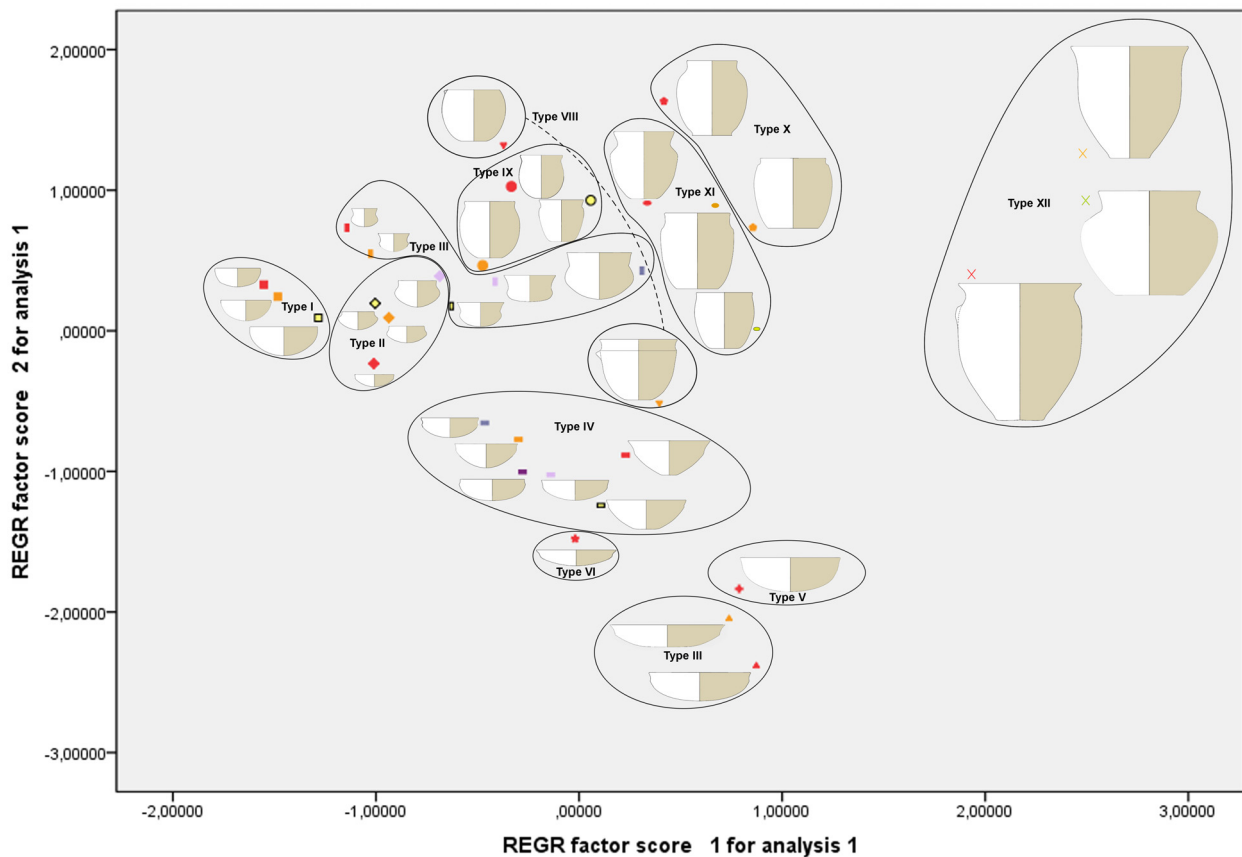


Fig. 7. Diagram with the different typology of Late Bronze Age of Cerro de Cabezuolos.

perhaps correspond to hearth bases, as occurs at El Cerro de la Encina (Arribas et al. 1974).

It is, therefore, a characteristic Late Bronze Age habitat with parallels in areas of Upper Andalusia and the southeastern Iberia, as demonstrated by the building finds documented in Trench IX at El Cerro del Real (Pellicer/Schüle 1966), Phase III of El Cerro de la Encina (Arribas et al. 1974), Trench elements 23 of El Cerro de los Infantes (Mendoza et al. 1981), and the Late Bronze Age settlement of El Peñón de la Reina (Martínez/Botella 1980). All these reveal an urban distribution of dispersed dwellings and stretches of defensive wall similar to those of El Cerro de Cabezuolos.

4.2. The Morphometry of Late Bronze Age Pottery

In this case, given the dimensions of the archaeological excavations carried out in the settlement of Cabezuolos, the number of vessels available for

a morphometric study was considerably smaller than at Peñalosa. However, the results provided information on the configuration of ceramic productions at this site. They also contribute to the knowledge of the Late Bronze Age in southeastern Iberia, as it is a single-phase settlement that would have been occupied for just a few generations during the most recent phase of that period (Dorado et al. 2015, 311).

The morphometric study made it possible to define 13 pottery types for this assemblage that represent all the forms found at the site (fig. 7). As in the previous case, they are divided between simple forms, mainly bowls of diverse sizes (Type I), and compound forms, that make up the remaining items studied (Types II–XII), consisting of vessels, plates, serving dishes and pots with carinations or narrowings on the neck. In addition to those, a final assemblage is represented by bobbin mounts with a central bead (Type XIII).

Other productions in clay or fired mud, such as the ducks found in Hut C, were not included in

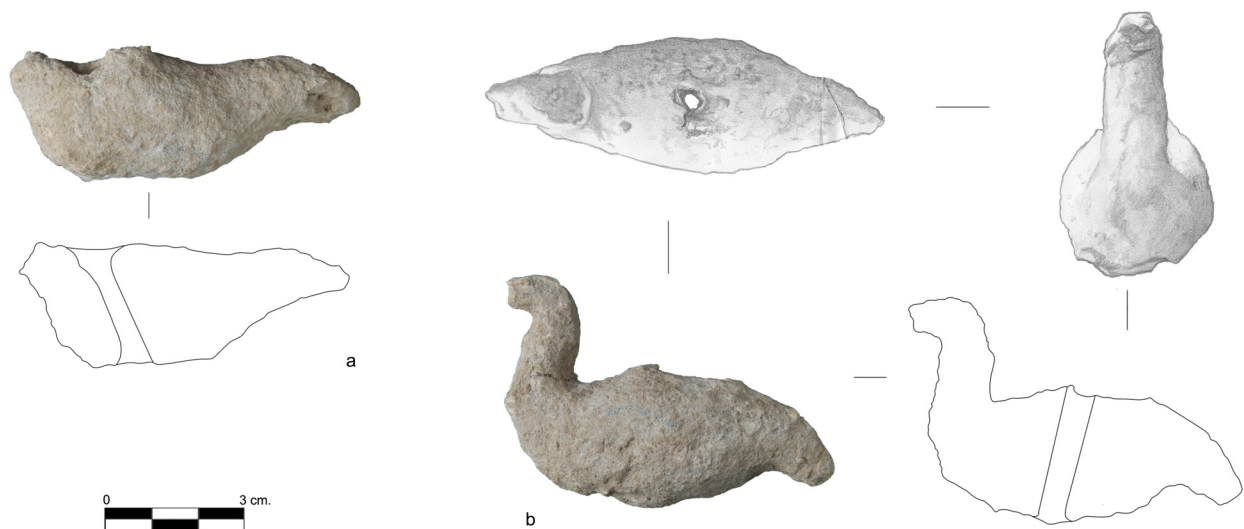


Fig. 8. Duck figures of Cerro de Cabezuelos.

the statistical test as they were not considered to be linked to service activities, production or the storage of raw materials (fig. 8).

4.3. Pottery Production and Maintenance Activities

The contextual attribution of the assemblage of finds from the archaeological excavations raises a series of questions about the use of the spaces attested by the distribution of pottery types and, along with it, the possible use and functionality of the different receptacles. It begins with Hut A, in which the space appears to have been distributed according to specific uses. Inside the hut there were abundant finds corresponding to tableware and, in larger proportions, storage ware, with those belonging to Type IV standing out, for example, plates, serving dishes and pots with middle and high carinations. They are followed by Types II and III, corresponding to flat vessels with straight, vertical, protruding-rim and globular vessels with marked necks. Finally, Types V, VI and VII were found among the tableware. These correspond to large, deep, carinated serving dishes, very flat carinated serving dishes with very protruding curved rims, and large, very flat, carinated serving dishes. As we can see, they are receptacles that can be linked to the

consumption of foodstuffs, either individually or collectively, and they would have formed part of daily domestic life.

Inside this dwelling there were also various forms linked to the production and storage of foodstuffs corresponding to Types IX, XI and XII, for example, small ovoid pots with marked necks and protruding rims, small ovoid jars with marked necks, and large jars. The finds in this assemblage of receptacles show a picture of a domestic life in which the storage, production and distribution of foodstuffs were daily tasks carried out inside the dwelling. However, it also should be pointed out that not all the finds corresponding to consumption, production or storage were found inside the hut, as sherds of various Types I, II and III vessels were also found outside. These can be explained as items whose usefulness had expired that had been thrown in the rubbish dumps near the exterior of the dwelling.

Inside Hut B once again abundant examples of pottery used for consumption were found. In this case, Type III was the best represented, followed by Type IV, with two pieces, and Types II and VII, both with a single vessel. In contrast to in the previous hut, the large, deep, carinated serving dishes and the very flat carinated serving dishes with very protruding curved rims were not represented in the internal space. This is not the case of foodstuff storage and production ware, which

was represented by Types IX and XII, with two individuals each, and Type XI with one individual. Thus, the same types of pottery patterns in the interior were observed, where individual consumption ware and foodstuff processing and storage ware would have occupied the different spaces. Regarding the exterior, a pre-eminence of vessels related to foodstuff storage and processing, as shown by Types VIII, IX, X and XII has to be mentioned. Once again, the few sherds of consumption ware – Types II, III and IV – have to be linked to discarded items that had become useless.

Finally, Hut C that, although containing a smaller amount of pottery, provided a context with a greater variability of archaeological finds. The interior yielded containers attributed to Types I, II, III and VII, the only hut in the settlement in which the simple, non-carinated forms were found. On the other hand, among the vessels for processing and storing foodstuffs, Types VIII and XII were documented in the same amounts as in the previous huts. On the outside of this hut two vessels identified as Types II and III were identified, that is vessels with a straight, vertical, protruding rim, and small globular-shaped vessels with a marked neck. The proportions of storage and foodstuff processing vessels were once again higher; they were attributed to Types VIII, X and XII, which allows to consider the disassociation of spaces according to specific functions.

From all this, a greater representation of forms attributed to the types linked to the consumption of foodstuffs in the interior of the huts with respect to those types used for foodstuff storage and processing can be defined. Firstly, the vessels and small receptacles corresponding to Types II and III were found in all the huts (except for Type I that was missing from Hut B) and appeared to be linked to the individualised consumption of foodstuffs and especially drink. Secondly, of particular note were those types for which the consumption or presentation of the foodstuffs could have been collective, among which Types V and VI were found, with representation in Hut A, and Type VII, located in all the dwellings. Finally, the ware destined for foodstuff storage and processing was found to a greater or lesser extent in the interior of all the huts.

However, there appears to be a polarisation in the contextual representation of the different types according to the space. Thus, although in the interior of the dwellings more vessels used for consumption and fewer for storage and processing were found, outside the huts the situation is reversed. Vessels linked to consumption are also found in the external zones of the huts, with a predominance of Types II and III and, to a lesser extent, Type IV, although they are always discarded or in dumps. The concentration of medium- and large-sized vessels in external areas leads to believe that the spaces adjoining the huts may have served not only as rubbish dumps but also as auxiliary areas for domestic activities, where foodstuffs and raw materials would also have been processed and stored.

5. Discussion and Conclusions

The results obtained through the morphometric study of the ceramic assemblages from these sites reveal a wide diversity of forms which have made it possible to define the different maintenance activities carried out during the Bronze Age. The relations between the ceramics and their contexts disclose a change in the dynamics of settlement. While Peñalosa shows a concentration of activities inside the huts, with few traces being found outside them, the case of Cabezuelos shows differences between the activities carried out outside and inside of the huts.

However, the formal difference in ceramics between the two sites reveals a lack of continuity in the pottery tradition between the Argaric and the Late Bronze Age societies; such has been documented in different sites in southern Iberia (Contreras 1986; Aranda 2001). Despite the fact that in both settlements the vessels seem to have been designed to fulfil the same function, substantial changes can be observed in the ceramic types between the two periods, following the guidelines defined for other settlements in the same chronological and cultural environment: Cerro de la Encina or Cuesta del Negro. These changes can be seen fundamentally in the replacement of the convex base (Argar period), flat backgrounds

(Late Argar Period) or in much more marked carination (Late Bronze Age).

These differences are linked with changes in food consumption and processing patterns between both moments, as well as with different social structures and different cultural traditions. Therefore, during the Late Bronze Age the settlement of Cerro de Cabezuelos might receive new influences from other areas of the Iberian Peninsula or the Mediterranean. These cultural changes are also reflected in the adoption of ceramic figurines during the Late Bronze (such as ducks) which were not present during the Argar period.

Furthermore, in the landscape these sites show certain similarities. For example, they are both strategically located in a territory to control routes of communications between Upper and Lower Andalusia, as well as other areas of the Levant of the Iberian Peninsula. In the case of Peñalosa, its occupation was closely linked to the exploitation of mineral resources related to the metallurgical process. This is demonstrated by the large quantity of ceramics destined to these purposes, as well as the mineral and metallic elements found, in contrast to Cerro de Cabezuelos. However, there is evidence that its relationships

with the surrounding territory must have existed, as is shown by the presence of amphibolites, micaschists or the presence of ceramic sherds that were not made with local clays (Dorado et al. 2015, 297–300; Dorado 2020, 110–112). However, it is clear that the necessary control of the main routes determined the position of both sites. Moreover, this pattern of land occupation is also evident in the different ways in which the settlements are occupied: settlements with strong slope in the Argar period versus settlements on hills with a lesser slope during Late Bronze Age.

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Bibliography

- Alarcón 2010*: E. Alarcón, Continuidad y cambio social. Análisis de las actividades de mantenimiento (PhD-Thesis University of Granada 2010).
- Alarcón 2015*: E. Alarcón, Social Relations between Adulthood and Childhood in the Early Bronze Age Site of Peñalosa (Baños de la Encina, Jaen, Spain). In: M. Sánchez Romero/E. Alarcón/G. Aranda (eds.), Children, Identity and Space. Childhood in the Past Monograph Series 4 (Oxford 2015) 59–74.
- Aranda 2001*: G. Aranda, El análisis de la relación forma-contenido de los conjuntos cerámicos del yacimiento arqueológico del Cerro de la Encina (Granada, España). British Archaeological Reports. International Series 927 (Oxford 2001).
- Arribas et al. 1974*: A. Arribas/E. Pareja/F. Molina/O. Arteaga/F. Molina, Excavaciones en el poblado de la Edad de Bronce “Cerro de la Encina”. Monachil, Granada (el corte estratigráfico n. 3). Excavaciones Arqueológicas en España 81 (Madrid 1974).
- Bagwell 2002*: E. Bagwell, Ceramic Form and Skill. Attempting to Identify Child Producers at Pecos Pueblo, New Mexico. In: K. Kamp (ed.), Children in Prehistoric Puebloan Southwest (Salt Lake City 2002) 90–107.
- Berducou 1990*: M. C. Berducou, La céramique archéologique. In: M. C. Berducou (ed.), La conservation en archéologie (Paris 1990) 78–119.

- Blasco 1994*: M. C. Blasco (ed.), El horizonte campaniforme de la región de Madrid en el centenario de Ciempozuelos (Madrid 1994).
- Contreras 1984*: F. Contreras, Clasificación y tipología en Arqueología. El camino hacia la cuantificación. Cuadernos de Prehistoria de la Universidad de Granada 9, 1984, 327–385.
- Contreras 1986*: F. Contreras, Aplicación de métodos estadísticos y analíticos a los complejos cerámicos de la Cuesta del Negro (Purullena, Granada) (PhD-Thesis University of Granada 1986).
- Contreras 2000*: F. Contreras (Coord.), Proyecto Peñalosa. Análisis histórico de las comunidades de la Edad del Bronce del Piedemonte Meridional de Sierra Morena y Depresión Linares-Bailén. Arqueología Monografías 10 (Sevilla 2000).
- Contreras/Moreno 2015*: F. Contreras/M. A. Moreno, Minería y metalurgia del cobre entre las poblaciones argáricas. La aportación del poblado de Peñalosa. In: J. L. López (ed.), Phicaria III. Encuentros Internacionales del Mediterráneo (Mazarrón, 7–9 March 2014) (Mazarrón 2014) 37–57.
- Contreras et al. 2005*: F. Contreras/J. Dueñas/A. Jaramillo/A. Moreno/L. Arboledas/D. Campos/J. García/A. A. Pérez, Prospección arqueometalúrgica de la cuenca media y alta del río Rumbalar (Baños de la Encina, Jaén). Anuario Arqueológico de Andalucía 2003.II, 22–36.
- Contreras et al. 2014*: F. Contreras/A. Moreno/L. Arboledas/E. Alarcón/A. Mora/J. J. Padilla/A. García-García, Un poblado de la Edad del Bronce que tiene mucho que decir. Peñalosa. Últimas novedades en la acrópolis oriental. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 24, 2014, 347–390.
- Cortés 2007*: H. Cortés, El papel de los elementos cerámicos en los procesos metalúrgicos. El caso de Peñalosa, Grupo Estructural VI. Arqueología y Territorio 4, 2007, 47–69.
- Dorado 2020*: A. Dorado, En busca del eslabón perdido. Tras los gestos que definen la tradición alfarera del Bronce Final del Sudeste (1300–725 cal AC) desde el Cerro de Cabezuelos (Úbeda, Jaén). Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 30, 2020, 81–116.
- Dorado et al. 2015*: A. Dorado/F. Molina/F. Contreras/T. Nájera/F. Carrión/L. Sáez/F. De la Torre/J. Gámiz Caro, El Cerro de Cabezuelos (Jódar, Jaén). Un asentamiento del Bronce Final en el Alto Guadalquivir. Cuadernos de Prehistoria y Arqueología de la Universidad de Granada 25, 2015, 257–347.
- Dorado et al. 2020*: A. Dorado/J. F. Sol Plaza/A. M. Adroher, La transformación de las estructuras defensivas entre el Bronce Final y los primeros momentos de la Edad del Hierro en el sudeste de la Península Ibérica. In: A. Guerrero Martín (ed.), Imperialismo y Ejércitos (Granada 2020) 39–60.
- Esquivel/Contreras 1984*: J. A. Esquivel/F. Contreras, Una experiencia arqueológica con microordenadores. Análisis en Componentes Principales y Clusterización. Distancia Euclídea y de Mahalanobis. In: XIV Congreso Nacional de Estadística, Investigación Operativa e Informática 1 (Granada 1984) 133–146.
- Esquivel et al. 1991*: J. A. Esquivel/F. Contreras/F. Molina/J. Capel, Una aplicación de la Teoría de la Información al análisis de datos definidos mediante variables cualitativas multiestado. Medidas de similitud y análisis cluster. Complutum 1, 1991, 53–64.
- Fernández 2011*: S. Fernández, Clasificación tipológica de la cerámica del yacimiento de la Edad del Bronce de la Motilla del Azuer (Ciudad Real, España). British Archaeological Reports. International Series 2377 (Oxford 2011).
- García-García 2018*: A. García-García, La alimentación en la cultura del Argar. Análisis de residuos orgánicos de las cerámicas de Peñalosa (Baños de la Encina, Jaén) (PhD-Thesis University of Granada 2018).
- Gámiz 2018*: J. Gámiz, La cerámica neolítica de Los Castillejos (Montefrío, Granada). Estudio tipológico, decorativo y tecnológico (PhD-Thesis University of Granada 2010).
- González Vilchez et al. 1999*: M. C. González/G. García/F. González/M. González/F. Fernández, Estudio arqueométrico de un conjunto de piezas cerámicas del yacimiento arqueológico Valencina de la Concepción (Sevilla). In: J. Capel (ed.), Arqueometría y Arqueología (Granada 1999) 69–76.

- Harrison 1987*: R. Harrison, Beaker Cultures of Iberia. France and the West Mediterranean Islands. In: J. Guilaine (ed.), *L'âge du Cuivre Européen. Civilisation à vases campaniformes* (Paris 1987) 187–207.
- Hayden/Cannon 1983*: B. Hayden/A. Cannon, Where the Garbage Goes. Refuse Disposal in the Maya Highlands. *Journal of Anthropological Archaeology* 2.2, 1983, 117–163.
- Hunt et al. 2011*: M. Hunt/F. Contreras/L. Arboledas, La procedencia de los recursos minerales en el poblado de la Edad del Bronce de Peñalosa (Baños de la Encina, Jaén). Resultados de análisis de isótopos de plomo. In: V Simposio Internacional sobre Minería y Metalurgia Históricas en el Suroeste Europeo. Homenaje a Claude Domergue (León 2008) (Lérida 2011) 195–206.
- Lazarich 1999*: M. Lazarich, *El Campaniforme en Andalucía Occidental* (Cádiz 1999).
- Lull/Estévez 1986*: V. Lull/J. Estévez, Propuesta metodológica para el estudio de las necrópolis argáricas. In: Junta de Andalucía (eds.), *Homenaje a Luis Siret (1934–1984)* (Sevilla 1986) 441–452.
- Martín/Delibes 1989*: R. Martín/G. Delibes, La cultura del vaso campaniforme en las campiñas meridionales del Duero. El enterramiento de Fuente Olmedo (Valladolid) (Valladolid 1989).
- Martínez/Botella 1980*: C. Martínez/M. Botella, El Peñón de la Reina (Alboloduy, Almería). *Excavaciones Arqueológicas en España* 112 (Madrid 1980).
- Mendoza et al. 1981*: A. Mendoza/F. Molina/O. Arteaga/P. Aguayo/L. Sáez/M. Roca/F. Contreras/F. Carrión, Cerro de los Infantes (Pinos Puente, Granada). *Ein Beitrag zur Bronze- und Eisenzeit in Oberandalusien. Madrider Mitteilungen* 22, 1981, 171–210.
- Molina et al. 2017*: F. Molina/J. A. Cámara/A. Dorado/M. Villarroya, El fenómeno campaniforme en el Sudeste de la Península Ibérica. El caso del Cerro de la Virgen (Orce, Granada). In: V. S. Gonçalves (ed.), *Sinos e taças junto ao oceano e mais longe. Aspectos da presença campaniforme na Península Ibérica. Estudos e Memórias* 10 (Lisboa 2017) 112–129.
- Odriozola/Hurtado 2007*: C. Odriozola/V. Hurtado, The Manufacturing Process of 3rd Millennium BC Bone Based Incrusted Pottery Decoration from the Middle Guadiana River Basin (Badajoz, Spain). *Journal of Archaeological Science* 34, 2007, 1749–1803.
- Odriozola 2009*: C. Odriozola, The two Sides of the Guadiana. Inlaid Pottery from 3rd millennium BC alongside the Guadiana River (Spain and Portugal). In: T. K. Biró (ed.), *Vessels. Inside and Outside. 9th European Meeting on Ancient Ceramics*, Budapest (Budapest 2009) 119–122.
- Odriozola et al. 2012*: C. Odriozola/V. Hurtado/E. Guerra/R. Cruz-Aunón/G. Delibes de Castro, Los rellenos de pasta blanca en cerámicas campaniformes y su utilización en la definición de límites sociales. In: *Actas do IX Congresso de Ibérico de Arqueometria. Estudos Arqueológicos de Oeiras* 19 (Lisboa 2011) 143–154.
- Orton et al. 1997*: C. Orton/P. Tyers/A. Vince, A. La cerámica en Arqueología (Barcelona 1997).
- Padilla 2018*: J. J. Padilla, *Identidades, cultura y materialidad cerámica. Las Cogotas y la Edad del Hierro en el Occidente de Iberia* (Madrid 2018).
- Pellicer/Schüle 1966*: M. Pellicer/W. Schüle, El Cerro del Real (Galera, Granada). El corte estratigráfico IX. *Excavaciones Arqueológicas en España* 12 (Madrid 1966).
- Sullivan 1989*: A. P. Sullivan, The Technology of Ceramic Reuse. Formation Processes and Archaeological Evidence. *World Archaeology* 21.1, 1989, 101–114.
- Vico 2016*: L. Vico, La cerámica del Cobre Reciente de Los Castillejos (Montefrío, Granada). Estudio tipológico y decorativo. *Arqueología y Territorio* 13, 2016, 1–14.
- Vico et al. 2018*: L. Vico/F. Molina/C. Cámara/J. Gámiz, Estudio tecno-tipológico de las cerámicas del Cobre Reciente de los Castillejos (Montefrío, Granada). *Spal. Revista de Prehistoria y Arqueología* 27.2, 2018, 29–53.

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What can Technology do for Us?

Pottery as an Evidence of Society in Peñalosa (Baños de la Encina, Jaén)

Keywords: technology, function, use, social identity, collectivism, Bronze Age

Abstract

Pottery has always been very present in archaeological studies focused on the Bronze Age. However, this material element has traditionally been examined as a passive product defined by a series of formal and typological characteristics. In this work a different approach, which is founded on social technology and considers pottery assemblages as transmitters of social codes closely linked to the human groups that generate them, is proposed. Through the pottery material culture documented in the Argaric site of Peñalosa, a research focused on the anthropological concept of *chaîne opératoire* is planned. The objective is to rescue a large part of the social information still enclosed in these pottery sets. At first glance, the comparison of all the reconstructed pottery production processes seems to attest that the cultural structure of the societies that lived in this settlement a little more than 4,000 years ago was more complex and collective than had previously been assumed.

1. Introduction

Indeed, a technological study of material culture may be very useful to reconstruct the landscapes of past societies and the resources and strategies that these societies needed to survive in them. Nevertheless, except in some recent works (Colomer i Solsona 2005; Aranda Jiménez 2010; Albero Santacreu/Aranda Jiménez 2014; Alarcón García et al. 2018), most archaeological studies dealing with the Bronze Age potteries of the southeastern Iberian Peninsula only have focused their interest on reproducing and continuing the typological scheme established for this period by the Siret brothers at the end of the 19th cent. AD (Siret/Siret 1890). Since then, the classic definition of the ‘eight Argaric pottery forms’ has been very present in all researches on the recent prehistory in southeast Iberia, either to date relatively new discovered archaeological sites, or to strengthen the static and pre-established concept of Argaric culture. In this sense, the documentation of a specific series of pottery types has traditionally served to consolidate the idea that our past is linear and is made up of specific cultural groups, such as the Argaric.

Actually, from the 60s of the last century and the arrival of New Archaeology, other ways of

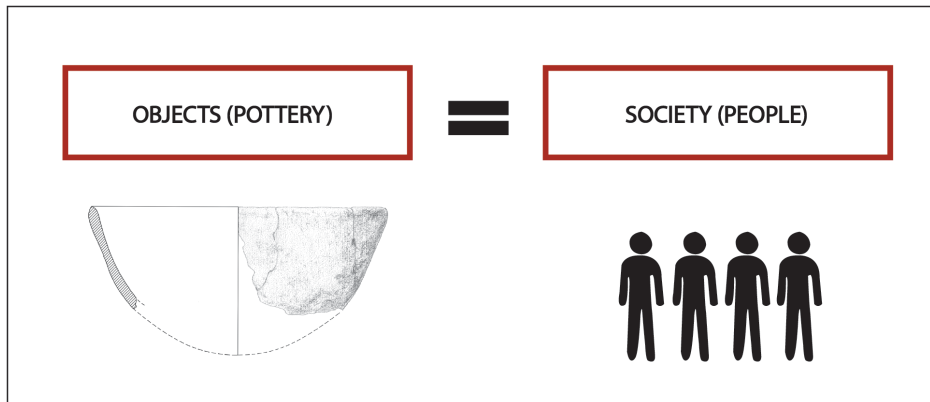


Fig. 1. Relationship between objects (pottery) and society (people).

understanding potteries appeared. They began to be considered as a material that may be approached scientifically and, as such, new analytical methodologies emerged to explore them from a technical perspective. For the first time, it was sought to connect the archaeological record with the human behaviour that generated it to be able to create complex social theories about our past. Bronze Age pottery assemblages started to be drawn, photographed, measured, and even technologically examined in physical terms. In fact, most generalist models, which try to explain how Argaric societies were based on universal rules and principles, derived from the interpretation of such data. But curiously, all these models turn out to be very familiar and similar to those that characterise or have characterised life in the West during the last hundred years. What is more, they seem to justify the behaviours and behavioural changes that have led to the balance and harmony of current progress (Lull/Risch 1996; Castro Martínez et al. 1999; Contreras Cortés/Cámara Serrano 2002; Lull et al. 2010; Cámara Serrano/Molina González 2011).

This paper proposes conceiving interpretations of Argaric societies from a different theoretical approach. That is, to assume that material culture is more than just a physical unit or a passive product, which creates and at the same time manifests the identity of the people who manufacture and consume it. In this regard, an examination of the object articulated in relation to people is intended to be launched. This relationship should be considered transcendental since material culture, in addition to enclosing social and symbolic values, plays a vital role in the ordering,

maintenance and subversion of social structures. In other words, there would be no people without objects or objects without people (*fig. 1*).

Obviously, the difficulty of propping up this conception lies in how to extrapolate it to the often-scarcely preserved and documented archaeological record. It is precisely here where technological praxis can be seen as a revealing strategy with great interpretive potential, because it is essentially configured as a true social phenomenon. Under this premise, the knowledge of technological aspects is not only useful to know the way in which objects are made or to know exactly the complete sequence of technical actions that are necessary to develop certain types (García Roselló/Calvo Trías 2013). The understanding of the technological fact as a 'system of durable, transferable, and structured dispositions but predisposed to function as structuring of structures' (Bourdieu 2008, 86), gives it an important role as a principal actor in social dynamics (Bentley 1987; Jones 1997). According to this logic, technological learning, for example, should not only be thought of as a mere transmission of technical knowledge and internalised psychomotor practices, but as a process of social construction that involves and transfers educational concepts closely connected with the philosophy and the specific structures of a given community (Martinelli 1996; Calvo Trías et al. 2015).

Basically, this work tries to construct a discourse in which people and objects are constituted with reciprocity. This notion also would allow the understanding of the archaeological context and its objects as participating actors in a stipulated social structure. The analysis of the pottery

practices, the archaeological record and their respective structures allows understanding the mental mechanisms as objective and, therefore, susceptible of study. This is undoubtedly encouraging for an archaeological research that aims to connect in a subjective but contrasted way with past communities. Accordingly, by acknowledging the relationships between the people who lived in the Bronze Age and their material culture, it will be possible to perceive both the conscious and unconscious realities of their own identity. In short, it might be possible to get a little closer to the world in which these people lived and the positions they occupied in it.

The works carried out for more than 30 years in the Argaric settlement of Peñalosa (Baños de la Encina, Jaén), dated between 2086–1450 calBC, offers the possibility of exploring in depth and in a practical way these aspects. A systematic and micro-spatial scale excavation system has led to the recovery of a well-preserved and exceptional archaeological record from the Bronze Age, in which pottery production occupies a very important place (Contreras Cortés 2000; Contreras Cortés et al. 2014). Taking into account a series of parameters, such as the ability to reconstruct the complete profiles of containers, the clear distinction of use marks and the technical patterns carried out, almost 1000 pottery sherds from domestic contexts and found in primary positions have been selected to undertake this study. The technological analysis of this material has permitted a global assessment of all the pottery elements documented in the IIIA (2086–1850 calBC) and IIIO (1850–1450 calBC) phases of occupation defined to date at this site (*fig. 2*).

2. Theory and Method

Before entering fully into the study of the pottery technological mechanics applied in Peñalosa during the Bronze Age, it is necessary to further develop the theoretical and methodological notions to be applied for this purpose. The leading interpretive scheme of this work is founded, on the one hand, on the Social Agency Theory that draws from Post-structuralism and, on the other, from Symmetrical Archaeology, which comes from the

Actor Network Theory. Therefore, it responds to a theoretical horizon that acknowledges the subjection of the human being to a specific order of social rules, even if one has the power to transgress them at any time. All together a bottom-up approach is projected, which initially fixes its attention on people and their interrelations in order to subsequently delve into the cultural order that constructs them and determines them as such.

From a critical position, the construction of archaeological narratives is then resorted to honest scientific discourses that do not question the logical meaning of what is investigated (Latour 1993; Shanks 2007). Under this premise, it does not matter if what is told about the past is rational or not, what really matters is its content. In other words, if what is being conveyed responds or not to the computation of categories that would define their own reality. For this reason, this research is also committed to carrying out ‘micro’ type readings of the archaeological record, which favour the generation of multiscale, no uniform and automatic interpretations.

To carry out such a study, the concept of structure must be used and understood as an effective instrument to inquire into the subjectivity of otherness (Sztompka 1994; Olson 1998; Hernando Gonzalo 1999). Leaving aside the outdated structuralist order of cultural rationality which establishes archetypes of human communities based on their degree of primitivism and scientific thought (Hernando Gonzalo 2003, 44), definitions as generic and abstract as that of structure can be very effective to clarify past behaviours. Strictly speaking, the structure governs in essence the identity of a human group, with the basic purpose to guarantee its survival (Lévi-Strauss 1990, 22). This refers to a dynamic code of philosophical approaches which appear ‘externally to human action’ to offer ontological security to the community in exchange for the restriction of their free initiative (Giddens 2006, 53). What’s more, structure manifests itself in material culture. This fact makes the latter a reflection of the values that in turn perceive it. Accordingly, objects would function as a language conveying consciously or unconsciously the life patterns that conceive them. Ultimately, it could allow the understanding of a given structure (Criado Boado 1999, 6–13; Olsen 2010, 10).

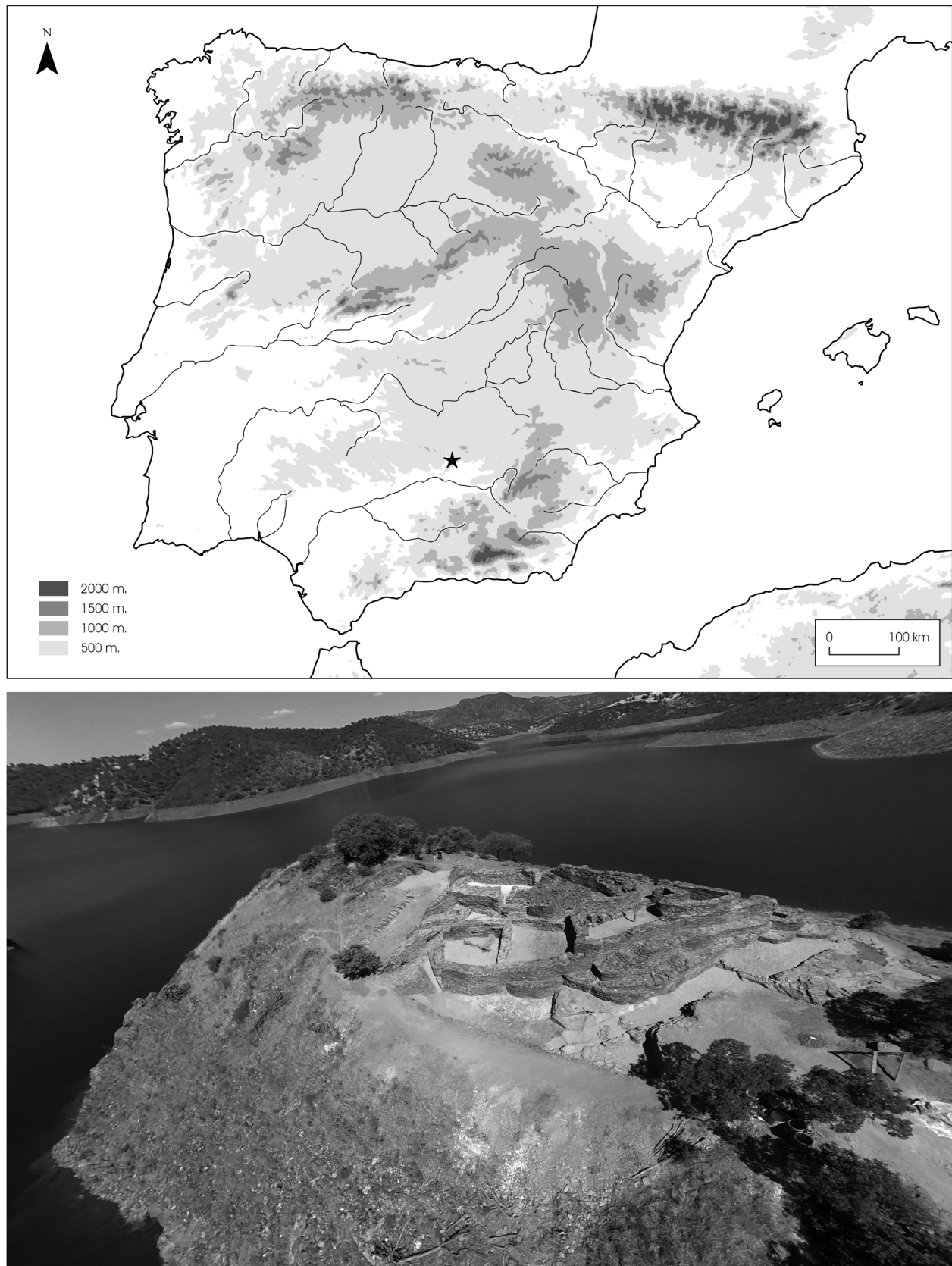


Fig. 2. Top: Geographical location of Peñalosa (Jaén, Spain). Bottom: General view of the archaeological site and the landscape related with it.

Based on these principles, archaeological research should focus its efforts on trying to decipher the meaning codes hidden in the material culture documented at the sites (Criado Boado 2012, 232). The close relationship between objects and people is beyond doubt. It could even be said that people and objects are inseparable entities, aligning like two sides of the same coin. Indeed, this reciprocal link supports the existence of an actual connection between context – spatial and temporal –, material culture and structure. Through this trinomial, objects are understood as ‘participating actors’ in the evolution of human societies, contributing to the stability and maintenance – transmission and inheritance – of their behavioural structures (Latour 2005, 100). Thus, contrary to the works that stress the recurrent separation of ‘active-human-actors’ and ‘receptive-passive-artifactual’ (Díaz de Liaño 2012, 144), the study of a model of society whose logic is constituted as a result of the intersection of people and material culture is proposed here.

Consequently, examining the norms established to make pottery in Peñalosa turns the pottery vessels found in this archaeological site into social containers. In order to precisely penetrate them, it is necessary to draw up a methodological proposal, which understands technology as a social practice and a system of cultural manifestation (Calvo Trias/García Roselló 2012). There are more and more works that delve into this approach and are able to demonstrate the effective connection between objects and techniques, or as Daniel Alberó Santacreu (2011, 527) states, between matter and thought. This study aims to be one of them. As previously introduced, it does not seek to point out merely the explicit set of prehistoric activities in a given social context (Dobres/Hoffman 1994). Pottery is above all a technology that, apart from solving basic socioeconomic needs, participates fully in the materialisation of specific modes of thought. From this perspective, technological studies become the perfect tool to explore in a practical way the relationship between the social actors and their daily lives (Dobres 2000).

On the premise that technology as a whole is the physical representation of a series of mental and social schemas, the search for how these

schemas are obtained becomes an essential aspect to address. Regardless of the context, learning processes are responsible for perpetuating the technological traditions of a given community over time. This occurs through the regulated acquisition of a specific number of techniques, which transmit technological knowledge, in one way or another, linked to certain social identities. The mechanisation of the ‘know-how’, that is, of each of the knowledge necessary to produce an object, allows not only to create tools for the daily needs of survival. They also transfer from generation to generation the relationships that articulate at the social level the specific behaviour and thoughts of a particular human group (García Roselló 2008).

Therefore, the detailed examination of the production sequences becomes a necessary action, since such provisions include exercises impossible to be directly noticed through the characteristics of the finished product. The execution of a series of technical gestures is the result of social learning in the course of manufacturing, which, sometimes, is hidden inside the objects themselves. Potteries, like the rest of the material culture, conceals in its technological process some strategic tasks that could be interpreted in terms of social identity. In this way, any technical gesture, from the acquisition of clay in the quarries to the firing of the pieces, should be regulated by social control (Colomer i Solsona 2005).

At this point, it makes sense to conceive technical gestures as social gestures. In order to obtain the maximum amount of social information, it is necessary to apply a procedure based on the systematic study of the technological process and its operational chains. Consequently, an alternative research centred on what Jaume García Roselló has called ‘Detailed Technological Process’ (2008, 81) is postulated. This means that technological studies, apart from analysing the productive sequences and their techniques, must also stress on the social context of production (Lemonnier 1993). Only in this way would a real approach to the set of choices and mental schemes resulting from a technological tradition imposed by a specific reality be possible. Undoubtedly, this is a type of thinking that aims to approach

material culture from anthropological visions, as if it was a human being.

In order to achieve everything described so far, the concept of *chaîne opératoire* established by Pierre Lemonnier (1986) in the 1980s is going to be used. This concept is defined as an analytical and interpretive tool that, apart from exposing the physical sequence of technical actions used to manufacture, use and repair a given object, serves to detail the effective correlations between matter, thought and social organisation (Calvo Trías/García Roselló 2014, 18). Accordingly, to reach the people who settled in Peñalosa in the Bronze Age, a well-defined method is established on two fronts. On the one hand, maximum effort is devoted to macroscopically reconstruct the different *chaînes opératoires* used for producing pottery. By means of a binocular magnifying glass, the physical operations that intervene to convert a series of natural resources into pottery pieces, from the material itself to technical knowledge, passing through energy, tools and gestures will be identified. On the other hand, the set of *chaînes opératoires* recomposed through the interpretation of the physical-chemical characteristics of the pottery elements and their manufacturing traces or marks are diachronically and synchronously examined. These observations and comparisons of every registered date, noted down in sequential tables through variables and variations, aim to verify the existence of changes or continuities in technical manufacturing operations and in technological and social cognition. In short, the objective is to detail the formal and non-formal regularity patterns and specify the variants within the defined model.

3. The pottery Assemblages of Peñalosa

The time has come to thoroughly analyse the technological patterns of the pottery pieces found in Peñalosa. Discerning these patterns will allow discovering the idiosyncrasy of a society in continuous evolution during the Bronze Age. This section is articulated around three large sections in which the three morpho-typological pottery groups conventionally documented in this archaeological site are explored. In each of them the different

chaînes opératoires are re-composed, paying special individualised attention to three major phases: 1) the selection, extraction and preparation of the raw material; 2) the modelling; and 3) the firing. From these steps, the physical traces still existing in the potteries are qualitatively and quantitatively examined to define afterwards the detailed actions and gestures carried out by the people in charge of their production. With the aim of not reproducing traditional canons that consider consumption potteries or finewares as the most important, this group will be addressed last. Indeed, they have been used to build the past based on universal and standardised reasoning, which is typical of the Western present and should be avoided.

3.1. Cooking Pottery

Morpho-typological studies that have been undertaken in Peñalosa have established 18 pottery types that from a physical point of view appear to have been linked to food processing and preparation. At the same time, these types have been generally organised into seven functional groups for purely metric reasons, such as diameters, heights and base and rim angles (Contreras Cortés 2000). Merely adhering to this classification, it would be presupposed that a heterogeneous collection of items that only share superficial signs of repeated exposure to fire is faced. On the contrary, the detailed technological analysis of these containers seems to show different results (Padilla Fernández et al. 2020) (*fig. 3*).

The mineralogical composition of the pottery matrices observed macroscopically point to the use of different clay sources coming from areas near both the archaeological site and between each other. The majority of the identified minerals – mica schist, feldspars, quartzes and micas – have been found to be closely linked to the igneous and metamorphic geological horizons predominant in the surroundings of Peñalosa (Jaramillo 2005). Moreover, their predominantly spherical shape leads to assume that they originate in areas with a high degree of erosion, possibly in the vicinity of the Rumblar River. Also, the absence of sharp edges and vertices reveals that these minerals were naturally part of the chosen clay. Nevertheless, this fact

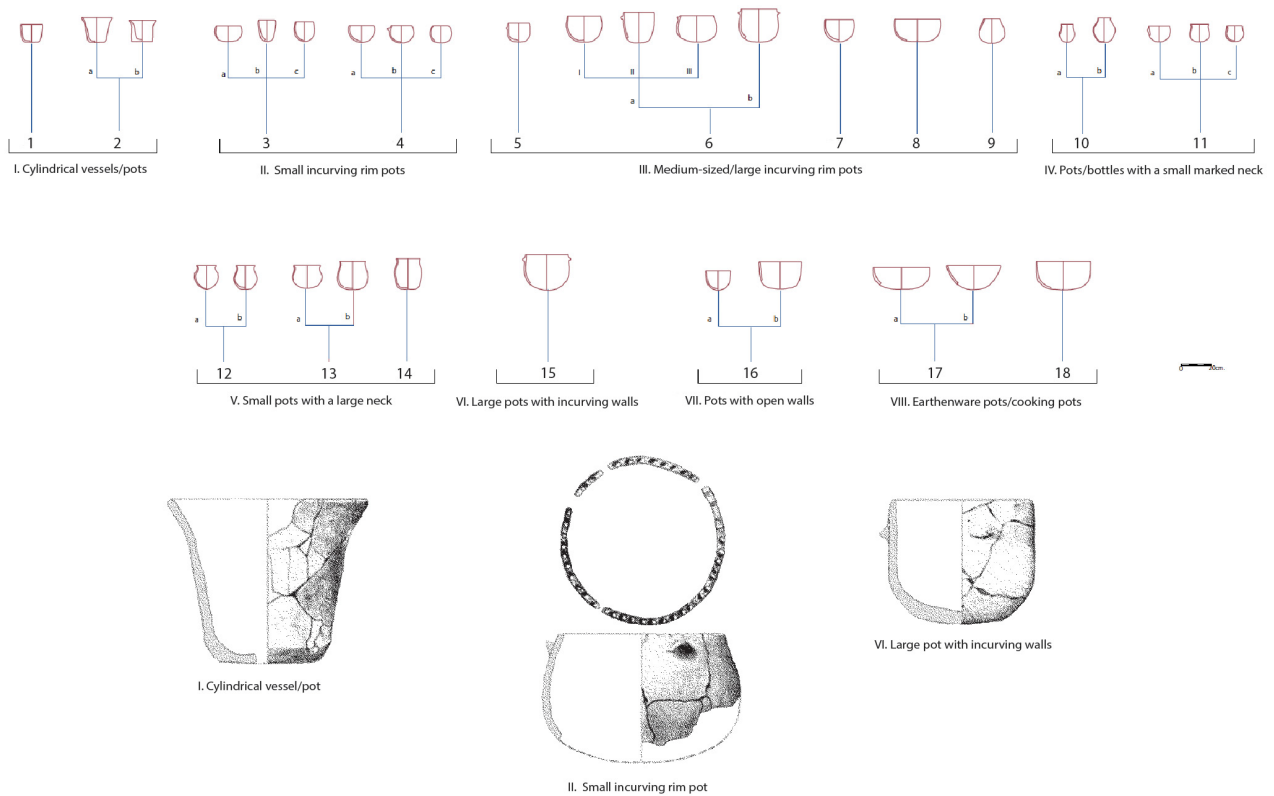


Fig. 3. Morphometric scheme of cookware done through the archaeological evidences found in the site of Peñalosa (Jaén, Spain).

does not contradict the execution of productive decisions linked to the deliberate removal or addition of tempers. In this sense, everything seems to suggest a very meticulous preparation of the clays. Organic and inorganic solids would have been removed by sieving, in a similar way to the methods seen in multiple ethnoarchaeological studies (González Ruibal 2005; Gosselain 2008; Djorjevic 2013). At the same time, and perhaps to endow the raw material with greater resistance to thermal contractions (Albero Santacreu 2008; Skibo 2013), we can also consider a possible premeditated addition of crushed quartz and ground calcite. The angular distinction of a part of the quartz crystals and the presence of average values of calcite could constitute a significant, although not definitive, indication that they had been added. Consequently, specific types of decantation may have been chosen according to the desired use and function of the final pottery product.

As soon as the clay had been selected and manipulated, it was trodden and kneaded, a decisive

sequence aimed at achieving the correct homogenisation of the ceramic pastes. The low rate of detection of clayey nodules and the minor frequency of variegations and air bubbles in the Peñalosa matrices evidence an efficient application of these techniques prior to the modelling of the clay. Once the clay reached the most suitable properties, the pottery containers were modelled. The modelling of the pottery would not have been conditioned by the use of rotation devices. The absence of parallel marks on the surfaces and the characteristic granulometrics on the observed sections reveal the application of technical gestures related to the superposition of coils from the base to the rim. Actually, the identification of flat and horizontal breakage traces and profiles full of 2cm wide concave intersection points rules out the use of other techniques. In contrast to the technological argument put forward for certain archaeological sites (van Berg 1998; Colomer i Solsona 2005), in the sample analysed from Peñalosa, it has so far been impossible to detect the use of moulding techniques.

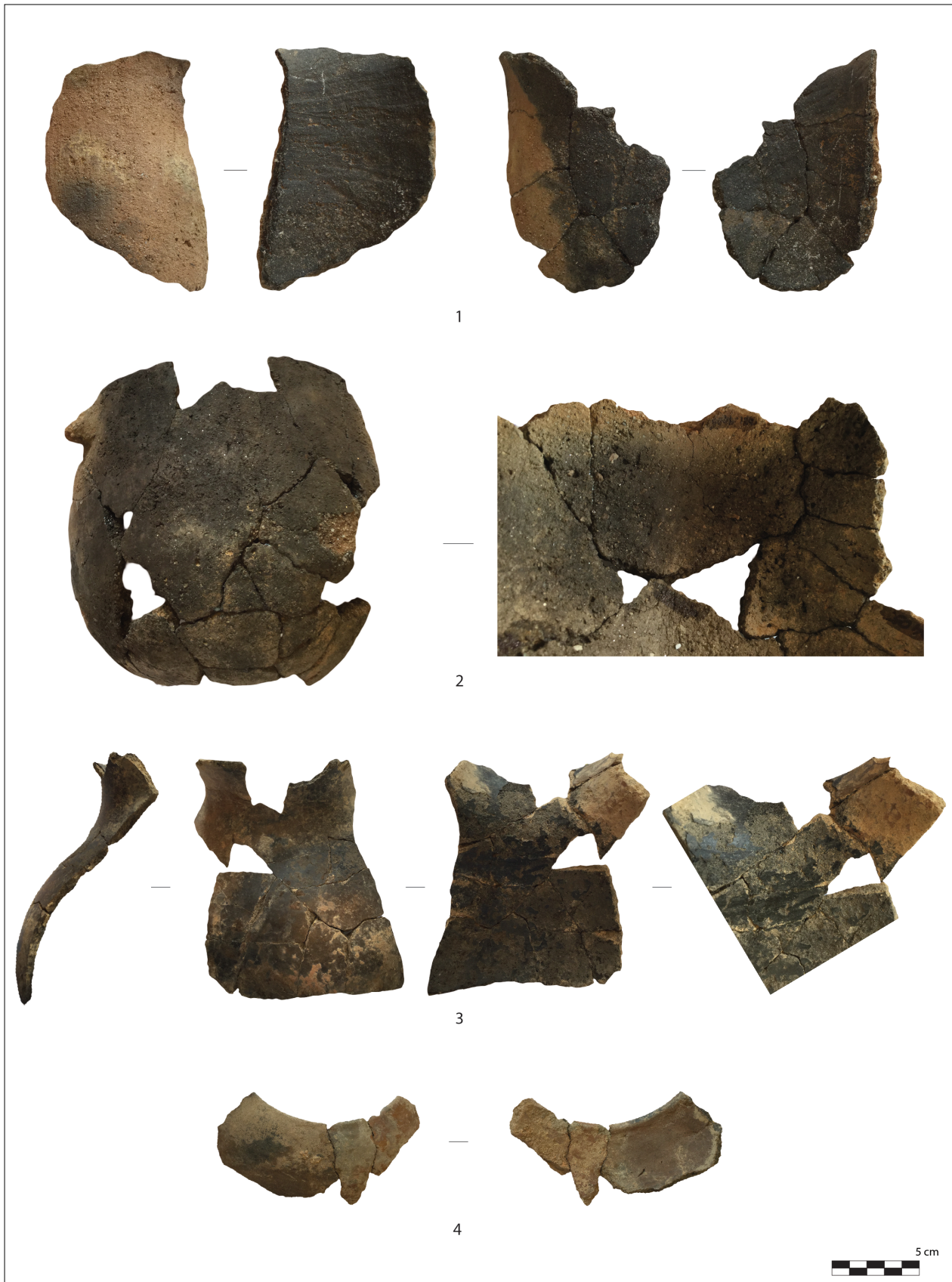


Fig. 4. Cookware documented in the site of Peñalosa (Jaén, Spain). They clearly show the different surface treatments used in the production process according to the predefined function and shape. Mild smoothing in a fresh state: 1. Inv. 50385; 2. Inv. 9405-2. Smoothing in the fresh and later burnishing in a leather-hard state: 3. Inv. 91007; 4. Inv. 25785.

If we focus on the gestures and technical actions carried out, they appear to correspond to a high degree of technical and formal skill. It is not easy to find signs of technical faults in the potteries, such as asymmetric deformations, continuous changes in thickness, irregular rims or coarse, cracked bases. Consequently, it could be presumed to have been well-defined and well-assimilated working methods. This pattern is shown in the final aspect and treatments of the surfaces applied to the pieces. Indeed, it is possible to perceive an apparent link between shape types and specific finishings. On the one hand, cylindrical and ovoidal vessels and pots, which show consistently a wider-diameter mouth, thicker walls and a rougher appearance, were lightly spatulated while fresh basically to smooth their exterior layers. On the other hand, globular vessels, pots and bottles and those pottery types with marked necks, which have a smaller-diameter mouth and thinner walls, were also initially spatulated. Nevertheless, they were later, when in a leather-like state, as well intensively polished, probably to seal any porosities emerging as a result of the loss of hydration and to make them waterproof (Echallier 1984). Finally, another group that encompasses the casseroles and earthenware pots, more similar to the first morphological group, tends to break with these established manufacturing guidelines. They are large, open pottery shapes that appear to have been not only smoothed but also subsequently burnished (*fig. 4*).

The decoration of these potteries materialises perfectly the cultural and self-identifying signs of the Argaric sphere (Aranda Jiménez 2004). Most pieces show nipple-like elements, ungulate incisions and impressions on the lips, as well as a very well-marked burnishing that, at the same time as waterproofing, also simulates a metallic finishing and texture.

After drying, these pieces would have been fired in mixed reducing atmospheres. Their study with a binocular loupe highlights the preponderance of brownish-reddish firing tonalities, a direct consequence of a high level of iron and a lack of oxygen entering the matrix (Roux 2016). The detection in some of the samples of small, clear and oxidising hues, fundamentally in the external strips, evidence the use of simple open combustion

structures as holes in the ground or ephemeral structures arranged on the surface. Unfortunately, these kinds of elements leave little or no traces in the archaeological record. Though, there are many ethnoarchaeological (Gosselain 1995; Livingstone-Smith 2007; Calvo Trías et al. 2011) and experimental (Calvo Gálvez 1992; Calvo Trías et al. 2004; Moreno Onorato et al. 2017) studies that have dealt with the particularities of this kind of firing structures. Special attention has been paid to the maximum temperature peak that they usually reach, which could be situated at approximately between 500 and 750°C. This thermal range has been confirmed by recent archaeometric performance of DRX analysis and reveals low peaks of chlorite and talc in Peñalosa potteries (Cámara Serrano et al. 2005; García García et al. 2020). Although their firing practices appear to have been rudimentary, the mastery of the technical gestures used to develop this last phase must be described as exemplary. There were no surface marks typical of poor firing, such as chipping, network and star cracks, or fractures.

3.2. Storage Pottery

The morpho-typological group of earthenware storage jars have been traditionally interpreted as such because of their medium or large size and the fact that grain remains have been sometimes found in them (Contreras Cortés 2000). They have been classified into six pottery types and further divided into three heterogeneous groups according to the inclination of their ridges. The technological study of a significant sample of these containers reveals other aspects that question this heterogeneity. It suggests, on the contrary, a manufacturing process based on a fairly marked technical planning (Padilla Fernández et al. 2020) (*fig. 5*).

The selection, extraction and preparation of the raw material show similarities with those already mentioned for the production of vessels linked to food preparation and cooking. XRF chemical analysis clearly display glimpses of the accumulation of non-calcareous and highly ferrous clays composed of minerals frequently found in the immediate geological area of the Peñalosa

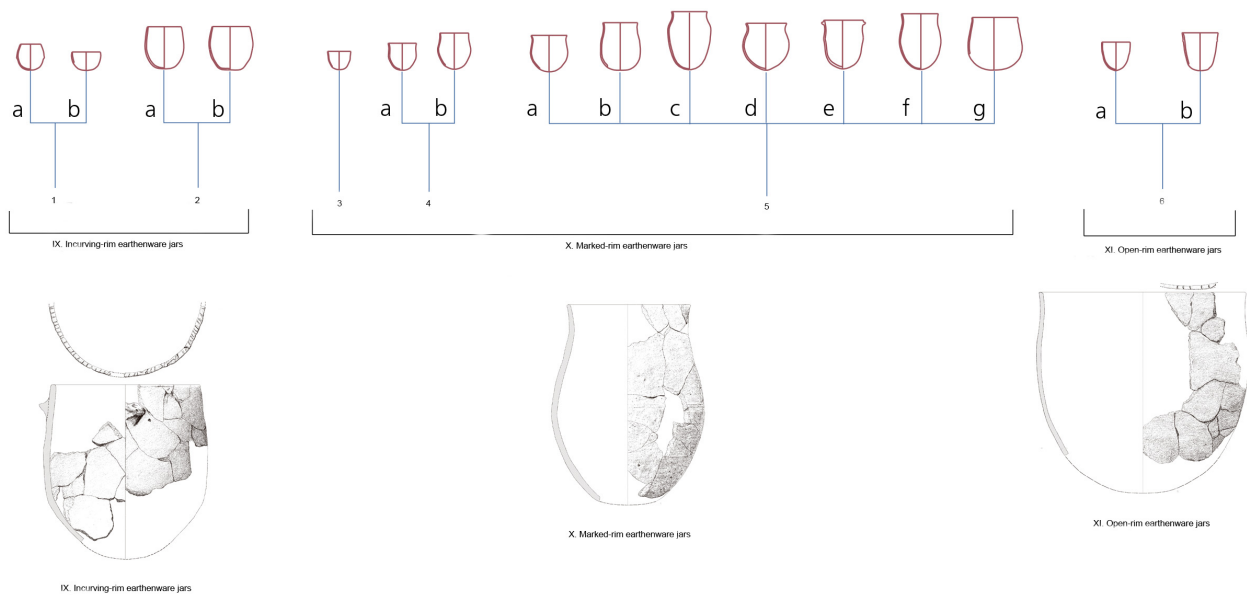


Fig. 5. Morphometric scheme of storage ware done through the archaeological evidences found in the site of Peñalosa (Jaén, Spain).

archaeological site (Cámara Serrano et al. 2005). The quantification of the tempers contained in the pottery matrices also attests a meticulous preparation of the selected clays. The identification of clasts with different densities points to the use of sieves with medium-sized meshes to remove impurities. Moreover, traces and rectangular holes have been macroscopically detected that prove the planned addition of threshed straw to the pottery paste. They are undoubtedly a further proof of the conscientious way the pottery pastes were prepared, in keeping with the specific functions and types. The functional aim that could justify the inclusion of vegetal elements could be connected to the need to diminish the proportion of water in the mixture, to ensure quicker drying, to lower losses in volume after firing or to reduce the weight of the final piece (Orton et al. 1997; Sestier 2005; Albero Santacreu 2007).

Treading and kneading as a prior step to modelling could also have been a constant and conscientiously undertaken process. The compacting of the clay particles that structure the matrix and the regular distribution of the natural or added tempers indicates this. The low presence of vacuoles caused by air bubbles and the sparse detection of knots as a consequence of uneven hardness

is evidence of a considerable homogeneity, quality and resistance.

The modelling of these pieces neither has required the generation of kinetic energy. All the types documented to date were made by continuously superimposing coils between approximately 3 and 6cm in width. It resulted in vessels with thick, strong walls and different surface finishings. The evident correlation between forms and the kind of textures applied is noteworthy. As such, we can distinguish two different specific pottery groups according to their surface treatment. On the one hand, there are containers that with the naked eye show less worked walls, having only been spatulated fresh and slightly smoothed in the leathery state. On the other hand, there are containers which present spatula marks and intense burnishes, covered by a thin layer of red slip demonstrating a high degree of skill (fig. 6).

The decorations applied to these pottery pieces correspond again to the Argaric canons (Sánchez Romero/Aranda Jiménez 2005). As specified earlier in the case of the pots, they are composed of nipples-like elements, ungulate incisions and impressions on the upper part of the lips and metallic burnishes. As an exception, the occasional use of red ochre for the slips should be mentioned. In this



Fig. 6. Storage ware documented in the site of Peñalosa (Jaén, Spain). It is possible to clearly appreciate the horizontal points of union of the overlapping coiling during the shaping process. 1. Inv. 281272; 2. Inv. 281292; 3. Inv. 25745.

case, rather than seeking an actual chromatic series associated with a specific ontology, this use may reflect a particular technological adaptation. It was probably for the purpose of maximising the sealing of certain containers designed with a smaller mouth diameter. This action would once again confirm the development of high technical expertise.

The macroscopic analysis of the Peñalosa earthenware jar pottery pastes supports the idea of an optimum technical knowledge of the firing process. The matrices show abundant mixed ranges of dark and brownish-reddish colours that lead us to believe that the pieces were fired in the same simple kilns described above. The maximum

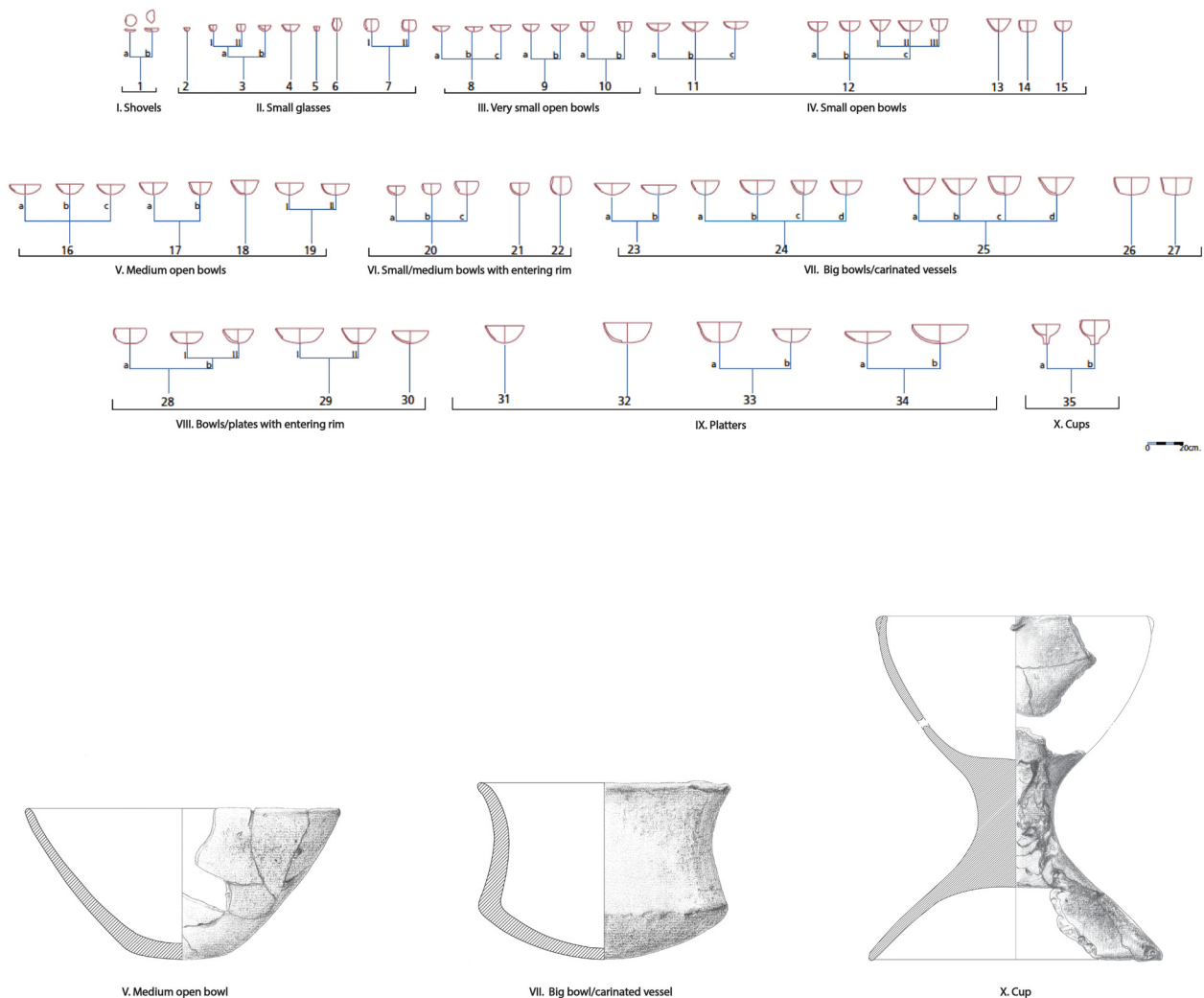


Fig. 7. Morphometric scheme of fine ware done through the archaeological evidences found in the site of Peñalosa (Jaén, Spain).

temperature indices hover around 700°C. This peak is confirmed not only by XRD (Cámara Serrano et al. 2005), but also by the presence of a considerable number of vascular and striated pores in the middle of the matrices, a consequence of the formation of gases and the concentration of clayey particles resulting of a firing with low thermal curves (Berducou 1990; Freestone 2001; Oakley/Jain 2002; Goffer 2007).

3.3. Fineware

Most small and medium-sized open forms documented in Peñalosa fall into this category. Based on metric and morphological perspectives, they have

been classified into 35 different types. However, they all belong to the typical Argaric range of items intended for the generic consumption of solid and liquid foods: bowls, plates, platters, carinated vessels and cups (Contreras Cortés 2000) (*fig. 7*).

From a technological point of view, these potteries present very similar patterns to those that have already been pointed out for both cooking and storage containers. With the aim of not repeating too many characteristics and identical technical gestures, in this section we will then focus on describing only actions that are different from those underlined above. Initially, the most important differences observed macroscopically are found in the decanting processes, the tasks related to the modelling of the pieces and the

treatment of their surfaces, as well as in the firing thermal rhythms.

Firstly, there is an absence of inorganic elements or traces that may evidence the existence of other organic solids in the pottery matrices. Thus, the tasks undertaken during the preparation of the selected clays may have been merely destined to eliminate possible harmful elements for the proper development of the pottery activity. On this occasion, this could confirm the use of the sieving technique to systematically expunge unwanted inclusions. On the contrary, the intentional addition of any type of temper with the purpose of modifying the nature of the chosen clays would be ruled out.

The modelling of these pottery types was again completely manual, although different technical actions were applied. The pastes reveal that the coils used here must have had considerably smaller dimensions – 0.5cm max. thickness – and have been joined by overlapping and internal lining. The surface treatments observed also corroborate the implementation of concrete gestures to achieve highly polished surfaces and metallic reflections. In addition, numerous sherds documented in Peñalosa belonging to this group present some decorations that can be linked to stylistic trends attached to what is known as the Culture of Las Cogotas. A priori, these two cultures coincide chronologically. Though, the Argaric world is geographically situated hundreds of kilometres away, on the northern peninsula plateau. Waiting for archaeometric studies to confirm the local character of the clays used in their manufacture, it is important to highlight that, for the most part, these pieces show macroscopically the same physical manufacturing characteristics seen in the rest of the pottery assemblages associated with consumption activities. The only prominent difference between the two sets can be found in formal considerations and decorative schemes. In fact, practically all of the fragments related to the Culture of Las Cogotas could be identified as tall carinated vessels with a truncated conical profile, which are decorated with simple compositions including short zigzag prints as well as incised circular or linear patterns (Contreras Cortés/Alarcón García 2012).

Ultimately, the macroscopic analysis of these pottery pastes shows the execution of technical operations during firing very similar to those

described above. However, the maximum temperature indices detected in this set would be somewhat higher, at around 800°C. The XRD archaeometric studies carried out confirm the extent of these firing temperatures (Cámara Serrano et al. 2005; García García et al. 2020), probably with the purpose of enhancing the emulation of the metal in said productions.

Unquestionably, these vessels were manufactured with a high degree of skill. Like the rest of the pottery sample analysed from Peñalosa, the application of the technical knowledge necessary to make this tableware seems almost perfect. Indeed, it is practically impossible to find variations between concavity and convexity, surfaces with depressions, bulges, cracks, burrs, linear fractures or any other sign that evidence a poor command of the projected technological sequence. In this sense, only a very minor group of small pottery vessels found in domestic contexts may contradict the stipulated norm. This set displays a very small size, asymmetric dimensions and technological malformations, such as cracks, grooves or surfaces with poorly executed treatments. They clearly correspond to miniatures made with a poor degree of ability that seem to imitate larger items, as if it were a learning process (Alarcón García et al. 2018).

4. Pottery and Society

Following the technological study, it is time to socially interpret the obtained data. We must then come back to the idea that technology is a social concept that allows access to unique information. In this section, a joint analysis of the techniques used to produce pottery containers in Peñalosa is proposed. The aim is basically to delve into the social reason behind these technical decisions.

The detailed comparison of the *chaînes opératoires* described draws attention to quite interesting data (fig. 8). First, power as a concept and its relations are shown as regulatory mechanisms that define the functioning and survival of Bronze Age societies. According to the observed technical traces, different ways of learning and reproducing pottery knowledge, which conform to a social structure imposed by specific power relations, are being somatised. The existence of several types of

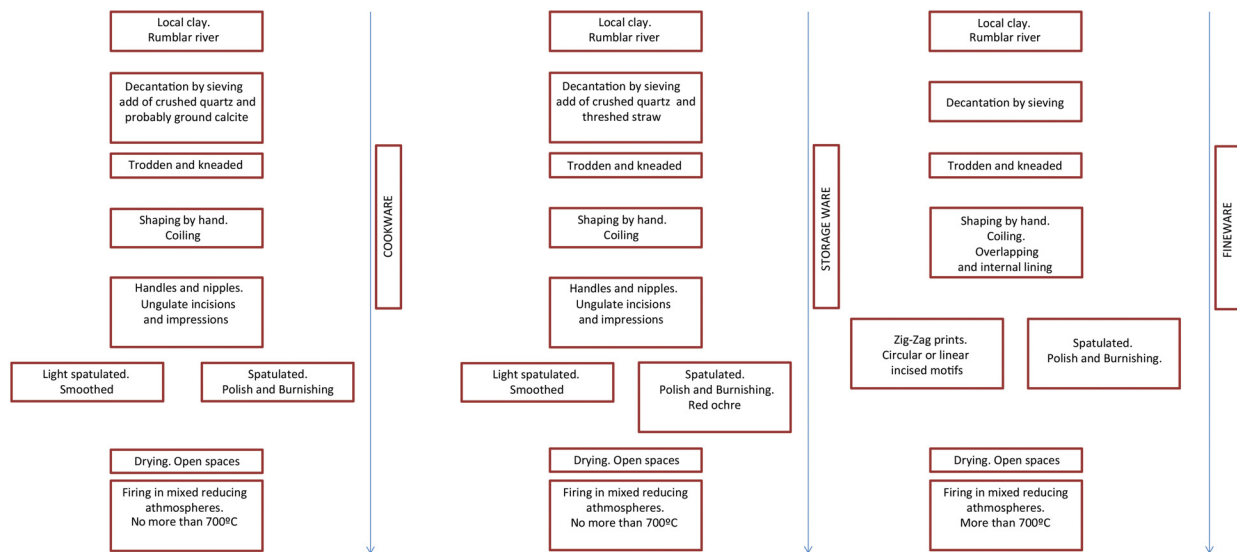


Fig. 8. *Châines opératoires* used to produce specialised pots, jars and vessels documented in the site of Peñalosa (Baños de la Encina, Jaén).

well defined ‘know-how’, with their own meaning but closely related to each other, indicates the establishment of a very marked knowledge transfer regime. This would have implied consolidated learning rhythms by enculturation agreeing with the achievement of definite uses and functionalities. In other words, specific technical actions and habits seem to certify high domains of expertise. In this sense, the appearance of optimum pottery productions and predetermined technical characteristics for storing, cooking or consuming in the Peñalosa archaeological record, should evidence the establishment of a social system based, among other things, on the empowerment of individuality as a concept in that societies. The technology of these potteries would then serve to intuit the reinforcement of a whole class of cultural strategies aimed at the conscious and unconscious affirmation of a world subject to increasing hierarchical organisation. Pottery goods with their technical peculiarities would be in charge of continuously reinforcing the principles truth of these new spheres of power, and thus helping to establish the feeling of difference of some people in front of others. The degree of importance that individuals themselves begin to have in social relationships is reflected on their efforts to create technologically appropriate containers to store fixed amounts of resources, make certain foods and beverages,

and consume them in precise settings and circumstances (Twiss 2012). Hence, the regular maintenance of the volumes and capacities of the pottery elements could also be conditioned by the cultural interest of establishing increasingly individualised quotas of power. Therefore, it is likely that the predilection for small and medium-sized containers in Peñalosa was related in some way to the social establishment of smaller and less communal management guidelines for storage and commensality.

Likewise, the study of the pottery productive process of Peñalosa can help to clarify the great dilemma that exists as to how the ordination of societies governed by members who held higher levels of individuality than those of the rest of the community would take place. The evidence seems to show that in this community a status negotiated to a certain extent with the group would be consolidated. In this way, a series of elites should have evolved that, generation after generation, had the mission of defending the rules of a life system that guaranteed the maintenance of their own perceptions of reality. Surely, the ostentation of such an important function within society necessarily entails a material distinction, based on the display of unique objects. This may be the reason why sherds with decorations emulating those from the Culture of Cogotas have been found in Peñalosa.

The procurement of pottery pieces with motifs similar to those typical of the societies of other regions could serve to demarcate some individuals with respect to the members of the same group. In turn, the possession of these vessels allows the owner to adhere to a select club of privileged ones that would end up reinforcing and giving meaning to this determined way of understanding the world. As Almudena Hernando Gonzalo (2002, 160 f.) states, the justification for this behaviour lies in the need that elites from Peñalosa had to consider themselves an integral part of a specific group. Because, despite the fact that the concept of hierarchy has an implicit logic of differentiation, failure to achieve a knowledge regime capable of rationally abstracting external reality must require perpetual connection to a social entity of parallel power. This power would then have been the one in charge of giving the inescapable feelings of orientation and security *vis-à-vis* nature and its dynamics.

The presence in Peñalosa of potteries formally linked to the Culture of Cogotas could also demonstrate that the connections established between societies of different regions were beyond the imitation or exchange of vessels for prestige reasons. The distinction of high skills in each of the productive phases of these particular pieces, as well as the selection of clays typical of geological contexts close to Peñalosa, reveals the institution of alliances and quotas of power through the creation of new kinship spheres via the exchange of women. In this case, families should not be understood as static entities. On the contrary, they would periodically undergo fusions or fissions due to multiple conditions (Ruiz Gálvez 2007). Based on these approaches, why not think that foreign women adopted by the community had actually made these foreign-style potteries? In essence, these material elements are in charge of always remembering their place of origin. Assuming that the Bronze Age world is increasingly revolving around a construct of elites motivated by a growing sense of male individuality (Hernando Gonzalo 2012; Padilla Fernández et al. 2020), marital relationships with other societies may well have supposed a physical displacement of the brides. Undoubtedly, this interesting issue demands for more social technological research focused on these unique

pottery fragments and continue to uncover their informative potential.

Finally, the domestic contexts documented in Peñalosa where the evident remains of pottery production processes described above were documented (Alarcón García/Mora González 2014, 90), allows us to suggest that Bronze Age human groups were very dynamic. They acted according to economic and social logics that are certainly barely understood from our modern perspective. In contrast to the studies that ponder more common and practical society archetypes during this period, based on pyramid structures with strong political and religious powers, great artisan centres and commanded by warrior leaders (Contreras Cortés/Cámara Serrano 2002; Cámara Serrano/Molina González 2011), in this work more collective organisations are proposed. The evidence of optimal and, therefore, specialised production phases in domestic contexts until the final phase of the settlement proves the existence of strong relational identities in that period. Although the beginning of the Bronze Age in the southeastern peninsula was probably a turning point in terms of the affirmation of individualised spheres of power, these communities should remain eminently relational. Certainly, the foundation of a greater economic and socially connected system brings about the appearance of small lineages that guaranteed higher quotas of power. However, the remaining bulk of the population must continue to have been based on basically relational notions of space and time. Not surprisingly, this bulk would be in charge of promoting the real subsistence of the groups by continuously carrying out acts of reciprocity. As such, during the Bronze Age trapezoidal societies may well have been common, where social differences between members and genders were not so antagonistic. This model should at the same time comprise the incipient emergence of various elites who identified and set apart themselves through a constructed image from which few material signs have come to us. Apart from the potteries themselves, specific weapons and exotic items, tattoos, clothing and even specific body languages could serve to distinguish a group of people respected for their experience and their broad perspective on things.

Under these premises and contrary to what happened especially in later times, it seems that women and their roles, among which pottery production, may not have been so invisible in Peñalosa and the Bronze Age. Starting from these more relational and collective positions, the knowledge and practices associated with daily life management could not be understood as secondary aspects by society, as they are currently considered. The specialised and predisposed production of potteries with specific uses would have been conceived as a significant activity within the tasks to be carried out in a domestic context, thus helping to consciously or unconsciously strengthen the community sense of survival. In this world, the act of eating was not only a mere biological function but also an action replete with 'social regulatory meanings' (Sánchez Romero 2008). Thus, the manufacture of pottery containers that are technologically appropriate for storing, cooking and consuming the foodstuffs generated every day would have been considered as a vital activity, together with the care and hygiene of domestic spaces, the protection of children or meals preparation and cooking. For this reason, it is even possible that women with an accredited pottery experience could have enjoyed a certain degree of social prestige within the community, given their inherited skills and technical knowledge.

5. Final Considerations

This paper aims, above all, to reflect. The academic tradition has shown a great interest in potteries, but almost always from morpho-typological perspectives. The objective was to establish chronological serials and lists of cultures associated with sound material assemblages. An Archaeological discipline cannot be content with analysing objects physically, but must go further. Indeed, the past is made up of people and is not a compendium of lifeless pieces. The need to obtain other social information forces us to observe material culture in a different way, that is, as an active agent that stores information about the human groups that produce and use it. This study aims, among other things, to show the possibilities of applying in archaeology a series of theoretical and

methodological approaches that focus on understanding pottery sets from an anthropological perspective. This type of approach makes possible to connect directly with the real and proper character of past societies. Because even the technical decisions made in certain production contexts give people their reason for being and structure their way of appreciating the world.

In this sense, a study focused on social identity through pottery technology also provides the opportunity to refine and renew the great generalist postulates which, from a modern or post modern individual perspective, project socio economic reasons onto the pottery technology. The verification of fully technical pottery operative chains defined in domestic contexts, which attend to specific principles of functionality and use, allows the construction of alternative interpretative discourses. Indeed, Bronze Age societies were immersed in growing and individualised processes of social hierarchy. It is likely that in the southeastern peninsula egalitarianism disappeared definitively during this period and more nuclear human communities were formed by small lineages. But this fact does not contradict the continued strong intra-community and inter-community relationship ties. In this case, these ties should only be different. Under this premise, the life success of enclaves such as Peñalosa depends on a division of functions. This motivates the articulation of various relational frameworks based on the advancement of the dynamics of social inequality. Pottery goods as a whole, with their formal representations and technical peculiarities, would be in charge of continually reinforcing the truth of the principles proper to these new spheres of power, helping to establish the feeling of difference of a few people compared to others. From this perspective, women should be valued by society since by carrying out their activities, including pottery production. They probably contributed to sustaining, protecting and transmitting the meaning of their social reality.

Even so, this attempt to interpret the social rhythms that marked the technical particularities of the potteries documented in Peñalosa must always be understood as a hypothesis. The cross-sectional reading of the manufacturing traces of archaeological potteries serves to infer the social function that technology could have had in the

Bronze Age without establishing, as it is logical, categorical truths. Social reconstruction of the past is a difficult task that requires much more work to be done in this regard. Therefore, the final considerations presented here are a starting point from which to establish future studies and reflections that may complete or deny them.

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Bibliography

- Alarcón García/Mora González 2014*: E. Alarcón García/A. Mora González, De la materialidad a la interpretación arqueológica. Análisis de las desigualdades sociales en el poblado argárico de Peñalosa. *Arkeogazte* 4, 2014, 83–107.
- Alarcón García et al. 2018*: E. Alarcón García/J. J. Padilla Fernández/S. García García/L. Arboledas Martínez, Learning to Be. Learning and Socialisation in Ceramic Productions during Bronze Age in Peninsular Southeast Spain. In: M. Sánchez Romero/R. M. Cid López (eds.), *Motherhood and Infancies in the Mediterranean in Antiquity* (Oxford 2018) 25–40.
- Albero Santacreu 2007*: D. Albero Santacreu, Primeras aproximaciones a la tecnología cerámica prehistórica en la Península de Calviá (Mallorca). *Arqueología y Territorio* 4, 2007, 70–86.
- Albero Santacreu 2008*: D. Albero Santacreu, La Calcita como desgrasante añadido en cerámicas arqueológicas prehistóricas. Estado de la Cuestión. In: Orjia (ed.), *I Congreso de Jóvenes en Investigación Arqueológica. Dialogando con la cultura material* (Madrid 2008) 93–100.
- Albero Santacreu 2011*: D. Albero Santacreu, Caracterización tecnológica, social y adaptación funcional de cerámicas prehistóricas del oeste y sureste de Mallorca (1750–50 BC) (PhD-Thesis Universidad de Granada 2011).
- Albero Santacreu/Aranda Jiménez 2014*: D. Albero Santacreu/G. Aranda Jiménez, Elección tecnológica y expresión social. Análisis arqueométrico de cerámicas funerarias argáricas del Cerro de San Cristóbal (Ogijares, Granada). *Complutum* 25.1, 2014, 109–127.
- Aranda Jiménez 2004*: G. Aranda Jiménez, Craft Specialization in Pottery Production during the Bronze Age in South-Eastern Iberia. *Journal of Iberian Archaeology* 6, 2004, 157–179.
- Aranda Jiménez 2010*: G. Aranda Jiménez, Entre la tradición y la innovación. El proceso de especialización en la producción cerámica argárica. *Menga. Revista de Prehistoria de Andalucía* 1, 2010, 77–95.
- Bentley 1987*: G. C. Bentley, Ethnicity and Practice. *Comparative Studies in Society and History* 29, 1987, 24–55.

- Berducou 1990*: M. C. Berducou, La céramique archéologique. In: M. C. Berducou (ed.), La conservation en archéologie (Paris 1990) 78–119.
- van Berg 1998*: P. L. van Berg, La Collection Siret à Bruxelles 2. La Céramique de la Culture d'el Argar (2300–1600 avant notre ère). Musées Royaux d'art et D'histoire (Brussels 1998).
- Bourdieu 2008*: P. Bourdieu, El sentido práctico. Siglo XXI (Salamanca 2008).
- Calvo Gálvez 1992*: M. Calvo Gálvez, Experimentando con la arcilla y el fuego como en la antigüedad. In: Asociación de Ceramología (ed.), Tecnología de la cocción cerámica desde la antigüedad hasta nuestros días (Alicante 1992) 41–43.
- Calvo Trías et al. 2004*: M. Calvo Trías/J. Fornés/J. García/V. Guerrero/E. Juncosa/C. Quintana/B. Salvá, La cerámica prehistórica a mano. Una propuesta para su estudio. El Tall (Mallorca 2004).
- Calvo Trías et al. 2011*: M. Calvo Trías/K. Gavua/J. García Roselló/D. Javaloyas Molina/D. Albero Santacreu, Social Approaches in Pottery Distribution Networks. The Case of Upper East Ghana. *Old Pots Almanac* 16.2, 2011, 13–17.
- Calvo Trías/García Roselló 2012*: M. Calvo Trías/J. García Roselló, Tradición técnica y contactos: Un marco de reflexión centrado en la producción cerámica. *Rubricatum* 5, 2012, 393–401.
- Calvo Trías/García Roselló 2014*: M. Calvo Trías/J. García Roselló, Acción técnica, interacción social y práctica cotidiana. Propuesta interpretativa de la tecnología. *Trabajos de Prehistoria* 71.1, 2014, 7–22.
- Calvo Trías et al. 2015*: M. Calvo Trías/K. Gavua/J. García Roselló/D. Javaloyas Molina/D. Albero Santacreu, Playing with Mud? An Ethnoarchaeological Approach to Children's Learning. In: M. Sánchez Romero/E. Alarcón García/G. Aranda Jiménez (eds.), *Children, Spaces and Identities* (Oxford 2015) 88–104.
- Cámara Serrano/Molina González 2011*: J. A. Cámara Serrano/F. Molina González, Jerarquización social en el mundo argárico (2000–1300 a.C.). *Quaderns de Prehistòria i Arqueologia de Castelló* 29, 2011, 77–104.
- Cámara Serrano et al. 2005*: J. A. Cámara Serrano/M. S. Milá Otero/R. Arana Castillo/F. Contreras Cortés, Estudio arqueométrico de diversos materiales cerámicos procedentes de Peñalosa (Baños de la Encina, Jaén). *Anuario Arqueológico de Andalucía 2002.II*, 2005, 37–50.
- Castro Martínez et al. 1999*: P. Castro Martínez/R. Chapman/S. Gili Suriñach/V. Lull/R. Micó/C. Rihuete/R. Risch/M. E. Sanahuja, Proyecto Gatas 2. La dinámica arqueológica de la ocupación prehistórica (Sevilla 1999).
- Colomer i Solsona 2005*: L. Colomer i Solsona, Cerámica prehistórica y trabajo femenino en el Argar. Una aproximación desde el estudio de la tecnología cerámica. In: M. Sánchez Romero (ed.), *Arqueología y Género*. Universidad de Granada (Granada 2005) 177–219.
- Contreras Cortés 2000*: F. Contreras Cortés (ed.), Proyecto Peñalosa. Análisis histórico de las comunidades de la Edad del Bronce del Piedemonte Meridional de Sierra Morena y Depresión Linares-Bailén. *Arqueología Monografías 10* (Sevilla 2000).
- Contreras Cortés/Cámara Serrano 2002*: F. Contreras Cortés/J. A. Cámara Serrano, La jerarquización social en la Edad del Bronce del Alto Guadalquivir (España). El poblado de Peñalosa (Baños de la Encina, Jaén). *British Archaeological Reports. International Series 1025* (Oxford 2002).
- Contreras Cortés/Alarcón García 2012*: F. Contreras Cortés/E. Alarcón García, La Cultura de Cogotas I y las comunidades orgánicas del Alto Guadalquivir. In: J. Fernández Manzano (ed.), *Cogotas I. Una cultura de la Edad del Bronce en la Península Ibérica. Homenaje a M^a Dolores Fernández-Posse* (Valladolid 2012) 65–186.
- Contreras Cortés et al. 2014*: F. Contreras Cortés/A. Moreno Onorato/L. Arboledas Martínez/E. Alarcón García/A. Mora González/J. J. Padilla Fernández, Un poblado de la Edad del Bronce que tiene mucho que decir. Peñalosa. Últimas novedades en la acrópolis oriental. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 24, 2014, 347–390.

- Criado Boado 1999*: F. Criado Boado, Del terreno al espacio. Planteamientos y perspectivas para la Arqueología del Paisaje. *Cadernos de arqueología e patrimonio* 6, 1999, 1–82.
- Criado Boado 2012*: F. Criado Boado, *Arqueológicas. La razón perdida* (Barcelona 2012).
- Díaz de Liaño 2012*: G. Díaz de Liaño, Cuando los objetos juegan un papel en la sociedad. Introducción a la Arqueología Simétrica. *ArqueoUCA* 2, 2012, 139–149.
- Djorjevic 2013*: B. Djorjevic, Pottery Making in Zlakusa. First Ethnoarchaeological Research Project in Serbia. In: F. Lugli/F. A. Stoppiello/S. Biagetti (eds.), *Ethnoarchaeology. Current Research and Field Methods. Conference Proceedings, Rome, Italy, 13th–14th May 2010*. British Archaeological Reports. International Series 2472 (Oxford 2013) 49–52.
- Dobres 2000*: M. A. Dobres, *Technology and Social Agency* (London 2000).
- Dobres/Hoffman 1994*: M. A. Dobres/C. Hoffman, Social Agency and the Dynamics of Prehistoric Technology. *Journal of Archaeological Method and Theory* 1.3, 1994, 211–258.
- Echallier 1984*: J. C. Echallier, *Éléments de Technologie Céramique et d'Analyse des Terres Cuites Archéologiques, Documents d'Archéologie Méridionale. Méthodes et Techniques* 3. CNRS (Paris 1984).
- Freestone 2001*: I. Freestone, Post-Depositional Changes in Archaeological Ceramics and Glasses. In: D. R. Brothwell/A. M. Pollard (eds.), *Handbook of Archaeological Sciences* (Chichester 2001) 615–625.
- García García et al. 2020*: A. García García/L. Vico Triguero/E. Alarcón García/J. J. Padilla Fernández/A. Mora González/A. Moreno Onorato/F. Contreras Cortés/E. Manzano Moreno/A. S. Cantarero Malagón/F. Martín Peinado, Pottery Grave Goods from Funerary Contexts at the Argaric Site of Peña-loza (Jaén). A Methodological Approach. *Journal of Ancient History and Archaeology* 7.3, 2020, 47–63.
- García Roselló 2008*: J. García Roselló, Etnoarqueología de la producción cerámica. Identidad y territorio en los Valles Centrales de Chile. *Mayurqa* 32. Monografía (Mallorca 2008).
- García Roselló/Calvo Trías 2013*: J. García Roselló/M. Calvo Trías, Making Pots. El modelado de la cerámica a mano y su potencial interpretativo. *British Archaeological Reports. International Series* 2540 (Oxford 2013).
- Giddens 2006*: A. Giddens, *La constitución de la sociedad. Bases para la teoría de la estructuración*. Amor-ortu (Buenos Aires 2006).
- Goffer 2007*: Z. Goffer, *Archaeological Chemistry* (Chichester 2007).
- González Ruibal 2005*: A. González Ruibal, Etnoarqueología de la cerámica en el oeste de Etiopía. *Trabajos de Prehistoria* 62.2, 2005, 41–66.
- Gosselain 1995*: O. P. Gosselain, *Identités Techniques. Le travail de la poterie au Cameroun méridional*. University of Brussels (Brussels 1995).
- Gosselain 2008*: O. P. Gosselain, Thoughts and Adjustments in the Potters Backyard. In: I. Berg (ed.), *Breaking the Mould. Challenging the Past through Pottery*. British Archaeological Reports. International Series 1861 (Oxford 2008) 67–79.
- Hernando Gonzalo 1999*: A. Hernando Gonzalo, Percepción de la realidad y Prehistoria. Relación entre la construcción de la identidad y la complejidad socio-económica en los grupos humanos. *Trabajos de Prehistoria* 56.2, 1999, 19–35.
- Hernando Gonzalo 2002*: A. Hernando Gonzalo, *Arqueología de la Identidad* (Madrid 2002).
- Hernando Gonzalo 2003*: A. Hernando Gonzalo, En la Prehistoria no vivieron “individuos”. Sobre los problemas de aplicación de la Teoría de la Acción a las sociedades prehistóricas. *Era-Arqueología* 6, 2003, 84–99.
- Hernando Gonzalo 2012*: A. Hernando Gonzalo, *La fantasía de la individualidad. Sobre la construcción sociohistórica del sujeto moderno* (Buenos Aires 2012).

- Jaramillo 2005*: A. Jaramillo, Recursos y materias primas en la Edad del Bronce del Alto Gualdaquivir. Medioambiente y registro arqueológico en la cuenca del Río Rumblar (PhD-Thesis Universidad de Granada 2005).
- Jones 1997*: S. Jones, *The Archaeology of Ethnicity. Constructing Identities in the Past and the Present* (London 1997).
- Latour 1993*: B. Latour, *We have Never Been Modern* (Cambridge 1993).
- Latour 2005*: B. Latour, *Reensamblar lo social. Una introducción a la teoría del actor-red* (Buenos Aires 2005).
- Lemonnier 1986*: P. Lemonnier, The Study of Material Culture Today. Toward an Anthropology of Technical Systems. *Journal of Anthropological Archaeology* 5, 1986, 147–186.
- Lemonnier 1993*: P. Lemonnier, *Introduction to Technological Choices. Transformation in Material Cultures since the Neolithic* (London 1993).
- Lévi-Strauss 1990*: C. Lévi-Strauss, *Antropología Estructural. Mito, sociedad, humanidades. Siglo XXI* (México 1990).
- Livingstone-Smith 2007*: A. Livingstone-Smith, *Chaîne Operatorie de la Poterie. Références ethnographiques, analices et reconstitution* (Tervueren 2007).
- Lull/Risch 1996*: V. Lull/R. Risch, El Estado Argárico. *Verdolay* 7, 1996, 97–109.
- Lull et al. 2010*: V. Lull/R. Micó/C. Rihuete/R. Risch, Las relaciones políticas y económicas de El Argar. *Menga. Revista de Prehistoria de Andalucía* 1, 2010, 11–36.
- Martinelli 1996*: B. Martinelli, *Sous le regard de l'apprenti. Paliers de savoir et d'insertions chez les forgerons Moose du Yatenga* (Burkina Faso). *Techniques et culture* 28, 1996, 9–47.
- Moreno Onorato et al. 2017*: A. Moreno Onorato/C. Bashore Acero/A. Dorado Alejos/J. J. Padilla Fernández, Experimental Reconstruction of Copper Metallurgy Based on Archaeometallurgical Remains from the Peñalosa Bronze Age Site. In: R. Alonso/J. Baena/D. Canales (eds.), *Playing with the Time. Experimental Archaeology and the Study of the Past*. Universidad Autónoma de Madrid (Madrid 2017) 269–274.
- Oakley/Jain 2002*: V. Oakley/K. Jain, *Essentials in the Care and Conservation of Historical Ceramic Objects* (London 2002).
- Olsen 2010*: B. Olsen, *In Defense of Things. Archaeology and the Ontology of Objects* (Plymouth 2010).
- Olson 1998*: D. R. Olson, *El mundo sobre el papel. El impacto de la escritura y la lectura en la estructura del conocimiento* (Barcelona 1998).
- Orton et al. 1997*: C. Orton/P. Tyers/A. G. Vince, *La Cerámica en Arqueología* (Barcelona 1997).
- Padilla Fernández et al. 2020*: J. J. Padilla Fernández/E. Alarcón García/S. García García/L. Arboledas Martínez/A. Moreno Onorato/F. Contreras Cortés/L. Chapon, *Between the Hearth and the Store. Pottery Specialization and Use in the Argaric Bronze Age Settlement of Peñalosa* (Spain). *Documenta Praehistorica* 47, 2020, 312–329.
- Roux 2016*: V. Roux, *Des ceramiques et des hommes. Décoder les assemblages archéologiques* (Nanterre 2016).
- Ruiz Gálvez 2007*: M. L. Ruiz Gálvez, *Loyal wives or just concubines...? Treballs d'Arqueologia* 13, 2007, 175–197.
- Sánchez Romero/Aranda Jiménez 2005*: M. Sánchez Romero/G. Aranda Jiménez, El cambio en las actividades de mantenimiento durante la Edad del Bronce. Nuevas formas de preparación, presentación y consumo de alimentos. *Treballs d'arqueologia* 11, 2005, 73–90.

- Sánchez Romero 2008*: M. Sánchez Romero, Actividades de mantenimiento, espacios domésticos y relaciones de género en las sociedades de la prehistoria reciente. In: L. Prados/C. Ruiz (eds.), *Arqueología del Género. Ier Encuentro Internacional en la U.A.M (Madrid 2008)* 93–104.
- Sestier 2005*: C. Sestier, Utilisation du dégraissant vegetal en contexte néolithique. Hypotheses technologiques et experimentation. *British Archaeological Reports. International Series 1349* (Oxford 2005).
- Shanks 2007*: M. Shanks, *Arqueología simétrica. Complutum 18, 2007*, 292–295.
- Siret/Siret 1890*: H. Siret/L. Siret, Las primeras edades del metal en el Sudeste de España. Resultados obtenidos en las excavaciones hechas por los autores de 1881 a 1887 (Murcia 1890).
- Skibo 2013*: J. M. Skibo, *Understanding Pottery Function* (New York 2013).
- Sztompka 1994*: P. Sztompka, Evolving Focus on Human Agency in Contemporary Social Theory. In: P. Sztompka (ed.), *Agency and Structure. Reorienting Social Theory* (Amsterdam 1994) 25–60.
- Twiss 2012*: K. C. Twiss, The Archaeology of Food and Social Diversity. *Journal of Archaeological Research* 20.4, 2012, 357–395.

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LANDSCAPES AND RESOURCES IN THE BRONZE AGE OF SOUTHERN SPAIN

Resources form the basis of the existence of societies. They can be material and immaterial, and their character is culturally shaped. Resources are usually not used in isolation, but in combination with other resources – as ResourceAssemblages that can change over time as a result of complex relationships. Dealing with such Resource-Assemblages shapes cultural landscapes in which social groups have their base and organise, shape and control these landscapes in a specific, culturally formed way according to the existing circumstances.

This volume focuses on the current state of research on resource use in the Bronze Age in the south of the Iberian Peninsula with a temporal perspective up to the present time. Short-term and long-term trends of landscape design to facilitate the utilisation of resources will be discussed as well as the interrelation of social dynamics and resource use.



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